SECOR
INTERNATIONAL
INCORPORATED

www.secor.com
3017 Kilgore Road, Suite 100
Rancho Cordova, CA 95670
916-861-0400 TEL
916-861-0430 FAX

June 31, 2006

Ms. Colleen Stone
California Regional Water Quality Control Board
North Coast Region
5550 Skylane Boulevard Suite A
Santa Rosa, California 95403

RE: **Response to RWQCB-NCR Letter Dated June 15, 2006 and Work Plan for Additional Site Assessment**
Bulk Plant No. 0220
720 North Franklin Street
Fort Bragg, CA
SECOR Project No.: 77CP.00927.06.1103

Dear Ms Stone:

SECOR International Incorporated (SECOR) has prepared this work plan on behalf of ConocoPhillips in response to the Regional Water Quality Control Board-North Coast Region (RWQCB-NCR) letter dated June 15, 2006 (Attachment 1).

Proposed scopes of work in this work plan include:

- Installing three off-site monitoring wells northwest of the site (Figures 1 and 2) to delineate the downgradient extent of petroleum impacts observed in groundwater related to the subject site.

- Performance of a sparging feasibility test at the site to determine the optimal injection pressures and flow rates needed to provide an adequate radius of influence to treat impacted subsurface materials with ozone sparge technology.

- Removal of the non-repairable existing ozone sparge system and replacement with a new more reliable brand of ozone sparge system (specifications and model type to be determined from the results of the sparge test).

BACKGROUND

The site is located near the north end of the city of Fort Bragg at the corner of Franklin Street and Spruce Street. Pudding Creek is located approximately 1,200 feet north of the site, and the Pacific Ocean is located approximately 2,400 feet west of the site. The facility was built in 1924 and currently consists of a storehouse, an office, a drum storage and filling area, five above ground storage tanks (ASTs), a pump area, and loading racks. Former components of the facility included two 550-gallon underground spill contaminant tanks (SCTs) used to collect

overflow spillage and overflow spillage with waste oil respectively, and a pump area. Product was historically supplied to the bulk plant by rail and for the past 30 years by truck. There are two separate unloading racks; one was to service rail cars (currently not in use) and the other to service trucks. Both the train and truck unloading racks serviced the bulk storage ASTs and loading rack via underground pipelines. The tank farm has a capacity of 85,000 gallons of storage with four 20,000-gallon ASTs and one 5,000-gallon AST.

PREVIOUS INVESTIGATIONS

In September 1988, Kaprealian Engineering Incorporated (KEI) conducted a preliminary site investigation that included the installation of six borings for soil and groundwater sampling (EB-1 through EB-6). The borings were advanced to a total depth ranging from 17 to 19 feet below ground surface (bgs). Total petroleum hydrocarbons with gasoline distinction (TPHg) and total petroleum hydrocarbons with diesel distinction (TPHd) were detected in soil and groundwater at concentrations ranging from 80 milligrams per kilogram (mg/kg) to 340 mg/kg, respectively (KEI, 1988).

On January 23, 1989, KEI oversaw the installation of four monitoring wells (MW-1 through MW-4) at the site. The wells were installed at depths ranging from 20 to 25.5 feet bgs. Groundwater was encountered at depths ranging from 10.5 to 14 feet bgs. All soil samples taken from the monitoring wells recorded non detectable concentrations of TPHg, TPHd, benzene, toluene, ethyl-benzene and total xylenes (collectively BTEX) except the ten foot sample from MW-4 which recorded a concentration of 790 mg/kg of TPHg. Groundwater samples taken from the wells contained concentrations of benzene ranging from 4.1 to 87 micrograms per liter (µg/L), concentrations of TPHg ranging from 2800 to 8800 µg/L, and concentrations of TPHd ranging from 1900 to 160,000 µg/L (KEI, 1989a).

On March 29, 1989, KEI oversaw the installation of five additional monitoring wells (MW-5 through MW-9) at the site. The wells were installed at depths ranging from 18 to 20 feet bgs. Groundwater was encountered at depths ranging from 9 to 15.5 feet bgs. Soil samples from the borings were analyzed for TPHg, TPHd, and BTEX. TPHg was found in the 10-foot sample from MW-5 at a concentration of 1.1 mg/kg. TPHd was detected in soil from MW-6 at a concentration of 400 mg/kg (KEI 1989b).

On July 26, 1989, KEI oversaw the installation of two additional monitoring wells (MW-10 and MW-11) at the site. The wells were installed at depths ranging from 19 to 20 feet bgs. Soil samples from the borings were analyzed for TPHg, TPHd, and BTEX. TPHg and TPHd were found in the 13-foot sample from MW-11 at concentrations of 31 mg/kg and 120 mg/kg, respectively. Groundwater samples taken from the MW-10 and MW-11 contained TPHd at concentrations of 180 µg/L and 540 µg/L, respectively (KEI, 1989c).

On September 1, 1995, KEI oversaw the installation of one additional groundwater monitoring well (MW-12) at the site. The well was installed at a depth of 19 feet bgs. Soil samples from the borings were analyzed for TPHg, TPHd, and BTEX. All soils recorded non-detectable concentrations of all analytes. Groundwater samples taken from the well contained TPHg, TPHd, benzene, toluene, and ethylbenzene at concentrations of 430 µg/L, 220 µg/L, 7.2 µg/L, 51 µg/L, and 12 µg/L, respectively (KEI, 1995).

In December 1996, KEI oversaw the removal of two 550 gallon spill containment tanks. During the excavation, KEI conducted a limited excavation around the vicinity of the tanks.

In February 1997, Pacific Environmental Group (PEG) conducted a Phase I site assessment of the site. To follow up with this assessment, on September 25, 1997, PEG oversaw the advancement of five soil borings (SB-1 through SB-4 and HB-1). The borings were advanced to depths ranging from 17.7 to 35 feet bgs. Soil samples analyzed from HB-1, SB-1, and SB-4 contained relatively low concentrations of TPHg and TPHd. The highest concentration of TPHg (37 mg/kg) and TPHd (28 mg/kg) were seen in the five-foot sample taken from SB-1 (PEG, 1998).

In February 1998, the quarterly monitoring activities at the site were taken over by Gettler-Ryan (GRI).

In September 1998, SHN Consulting Engineers & Geologists Inc. (SHN) prepared an interim corrective action plan (ICAP) for the site. In the ICAP, SHN recommended the installation of a supplemental oxygen source to enhance bioremediation processes at the site (SHN, 1998).

On April 12, 1999, SHN performed an additional subsurface investigation at the site. During the investigation, ten soil borings (SB-101 through SB-110) were advanced and abandoned, aquifer slug tests were performed on existing groundwater monitoring wells, and petroleum hydrocarbon fingerprinting was performed on the groundwater from the site. Based on the results of these three tests, SHN recommended the installation of a biosparge system (SHN, 1999).

During May and June of 2000, SHN supervised the installation of one bioventing test well, two biosparge wells, and three bioventing observations wells. A bioventing pilot test and a biosparge pilot test were conducted to determine the effectiveness of each method for site remediation. Based on the results of the pilot tests, the anticipated radius of influence for a bioventing system is 30 feet per well (SHN, 2000).

On December 5, 2002, SHN recommended the installation of 7 additional bioventing wells and 20 additional ozone sparge points at the site (SHN, 2002).

On October 8 and 9, 2003, SHN oversaw the installation of biovent wells (BV-2 through BV-8) and on October 7 through 10, 2004, SHN oversaw the installation of 20 ozone sparge wells (SP-1 through SP-20). Soil samples were analyzed from all the borings. The highest concentrations of hydrocarbons were found in soils taken from SP-7 and SP-18 (SHN, 2004).

The locations of soil samples taken during previous site investigations, and tables presented in historical site reports to summarize soil and groundwater analytical and characteristic data, are included in Attachment 2.

PROPOSED SCOPE OF WORK FOR MONITORING WELL INSTALLATION ACTIVITIES

SECOR proposes to install three groundwater monitoring wells (MW-13, MW-14, and MW-15) at the approximate locations shown on Figure 2. Work will be performed in accordance with SECOR's Field and Laboratory Procedures (Attachment 3). The specific scope of work is discussed below:

- Site Health and Safety Plan (HASP). As required by the Occupational Health and Safety Administration (OSHA) Standard "Hazardous Waste Operations and Emergency Response" guidelines (29 CFR 1910.120), and by the California Occupational Health and Safety Administration (Cal-OSHA) "Hazardous Waste Operations and Emergency Response" guidelines (CCR Title 8, Section 5192), a Health and Safety Plan (HASP) will be prepared. The HASP will be reviewed by the field staff and contractors before beginning field operations at the site.

- Permitting. All appropriate permits will be obtained from the Mendocino County Department of Public Health prior to initiating work.

- Borehole Clearance Activities. Prior to initiating field activities, SECOR will mark the boring locations, contact Underground Service Alert (USA) at least 48 hours prior to the initiation of field work, and contract a private utility locator to investigate whether the proposed boring locations are clear of potential subsurface obstructions. After clearance is verified by USA and the utility locator, the borings will be air knifed to a depth of approximately 5 feet bgs to further minimize the risk of encountering utility lines that are not anticipated at these locations.

- Groundwater Monitoring Well Installation. Three soil borings will be advanced at the locations shown on Figure 2 using hollow-stem auger drilling equipment. Eight-inch diameter soil borings will be advanced to a total depth of approximately 20 feet bgs, depending on the soil stratigraphy encountered. A 2-inch well will be completed within each borehole, and will be constructed with Schedule 40 PVC casing. Historical boring logs and cross sections have indicated that the site is underlain by a layer of silty to clayey sand, ranging in thickness from approximately 3 to 12 feet. A layer of silty and clayey gravel underlies this sand across most of the site, ranging in thickness from approximately 5 to 18 feet. Depth to the siltstone bedrock has been encountered in borings ranging from depths of 13 to 26 feet bgs. Depth to groundwater measured during monitoring events that have taken place over the last year have roughly ranged from 7 to 14 feet bgs. SECOR proposes to screen the monitoring wells in the main first water bearing zone between approximately 5 to 20 feet bgs, including the finer grained sediments if free water is encountered there, but excluding the possible perched zone.

- Monitoring Well Development/Sampling/Analysis. Groundwater monitoring wells will be developed by rigorously surging each well over the length of the screen interval and by purging approximately 10 casing volumes of water. Groundwater samples will be

collected and analyzed for the presence of TPHd by EPA Method 8015M, TPHg, BTEX, fuel oxygenates (MTBE, DIPE, TAME, ETBE, TBA and ethanol), and lead scavengers (1,2-DCA and EDB) by EPA Method 8260B.

- Well Surveying. Following installation, the newly installed groundwater wells will be surveyed by a licensed surveyor. Survey data including elevation, longitude, and latitude will be included in information uploaded to the State Water Resources Control Board (SWRCB) Geotracker Database in accordance with Assembly Bill (AB) 2886 requirements.

- Compliance with AB 2886 Requirements. Also per AB 2886 requirements, SECOR will electronically upload the data obtained during this investigation into the SWRCB Geotracker Database. Documentation of the electronic data format (EDF) submittals will be included in the final report.

- Soil and Water Disposal. Soil cuttings and water generated during drilling operations, well development, and well sampling will be temporarily stored onsite in DOT-approved 55-gallon drums pending characterization and disposal. Soil cuttings and water will be removed by a licensed disposal contractor and will be transported to an appropriate disposal facility.

- Report. Following the completion on-site activities, SECOR will submit a report documenting the installation of the new groundwater monitoring wells. The report will include soil boring logs, soil and groundwater analytical results, chain-of-custody documentation, well surveying data, AB 2886 confirmations, and conclusions/recommendations.

PROPOSED SCOPE OF WORK FOR SPARGING FEASIBILITY TESTING

Sparging feasibility tests will be performed in sequence using existing sparge wells SP-8 and SP-18 as air injection points. Each individual sparging feasibility test will last a total of 4 hours. SP-8 will use wells MW-4, BV-1 and OW-2 as observation points. SP-18 will use wells MW-8, BV-7 and BV-8 as observation points. The sparging feasibility test will be performed using a blower designed to operate at a minimum of 60 standard cubic feet per minute (scfm) at more than 25 pounds per square inch (psi). Depth to water and dissolved oxygen will be measured in the observation wells prior to, during, and at the end of the test. During the test induced pressure will be measured in the observation wells. Injection pressure will be measured at the sparge point. To determine the optimal injection pressure needed to create the appropriate radius of influence for the proposed new ozone sparge system the pre-determined injection pressures, flow rates and total time of injections will be monitored for each injection well. The pre-determined injection pressures are presented in Attachment 4.

PROPOSED SCHEDULE

Upon approval of this work plan, SECOR is prepared to initiate well installation activities with field work beginning approximately three to four weeks after the applicable permits are

received. The sparging feasibility testing activities can be completed within two to four weeks after work plan approval. Installation of the ozone sparge system can be implemented within two months from the completion of the sparging feasibility testing. A report documenting well installation and sparging feasibility testing activities will be provided to the HCDHHS within six to eight weeks of the completion of all field work and the receipt of analytical laboratory data.

Should you have any questions or concerns regarding this work plan, please feel free to contact the undersigned at (916) 861-0400.

Sincerely,
SECOR International Incorporated

Sean Coyle
Project Scientist

Adrian Perez, P.E.
Associate Engineer

Attachments
Figure 1 Site Location Map
Figure 2 Site Plan

Attachment 1 RWQCB-NCR Letter dated June 15, 2006.
Attachment 2 Tables and Maps from previous reports by KEI (October 18, 1988; March 1, 1989; April 21, 1989; August 30, 1989; November 29, 1995), PEG (February, 1998), SHN (September 9, 1998; September 28, 1999; October 19, 2000; December 5, 2002; July 9, 2004)
Attachment 3 Field and Laboratory Procedures
Attachment 4 Remediation Design Calculations for Ozone Sparge System

cc: Mr. Thomas Kosel, ConocoPhillips
Mr. David Smith, Mendocino Coast Petroleum, Inc. 720 N Franklin St. Fort Bragg, CA 95437
Mendocino County Health Department, 501 Low Gap Road, Room 1326, Ukiah, CA 95482

REFERENCES CITED

Kaprealian Engineering, Incorporated. 1988. Subsurface Investigation at Unocal Marketing Station, 720 N. Franklin Street, Fort Bragg, California. March 1.

Kaprealian Engineering, Incorporated. 1989a. Preliminary Ground Water Investigation at Unocal Marketing Facility, 720 N. Franklin Street, Fort Bragg, California. March 1.

Kaprealian Engineering, Incorporated. 1989b. Continuing Ground Water Investigation at Unocal Marketing Facility, 720 N. Franklin Street, Fort Bragg, California. April 21.

Kaprealian Engineering, Incorporated. 1989c. Continuing Ground Water Investigation at Unocal Marketing Facility, 720 N. Franklin Street, Fort Bragg, California. August 30.

Kaprealian Engineering, Incorporated. 1995. Continuing Ground Water Investigation Unocal Bulk Plant #0220, 720 N. Franklin Street, Fort Bragg, California. November 29.

Pacific Environmental Group, Incorporated. 1998 Summary of Assessment Activities Tosco Bulk Plan No. 0220, 720 North Franklin Street, Fort Bragg, California. February.

SHN Consulting Engineers & Geologists, Incorporated. 1998. Interim Corrective Action Plan Tosco (Former Unocal) Bulk Terminal #0220, North Franklin Street, Fort Bragg, California, Site ID #1NMCO48. September 9.

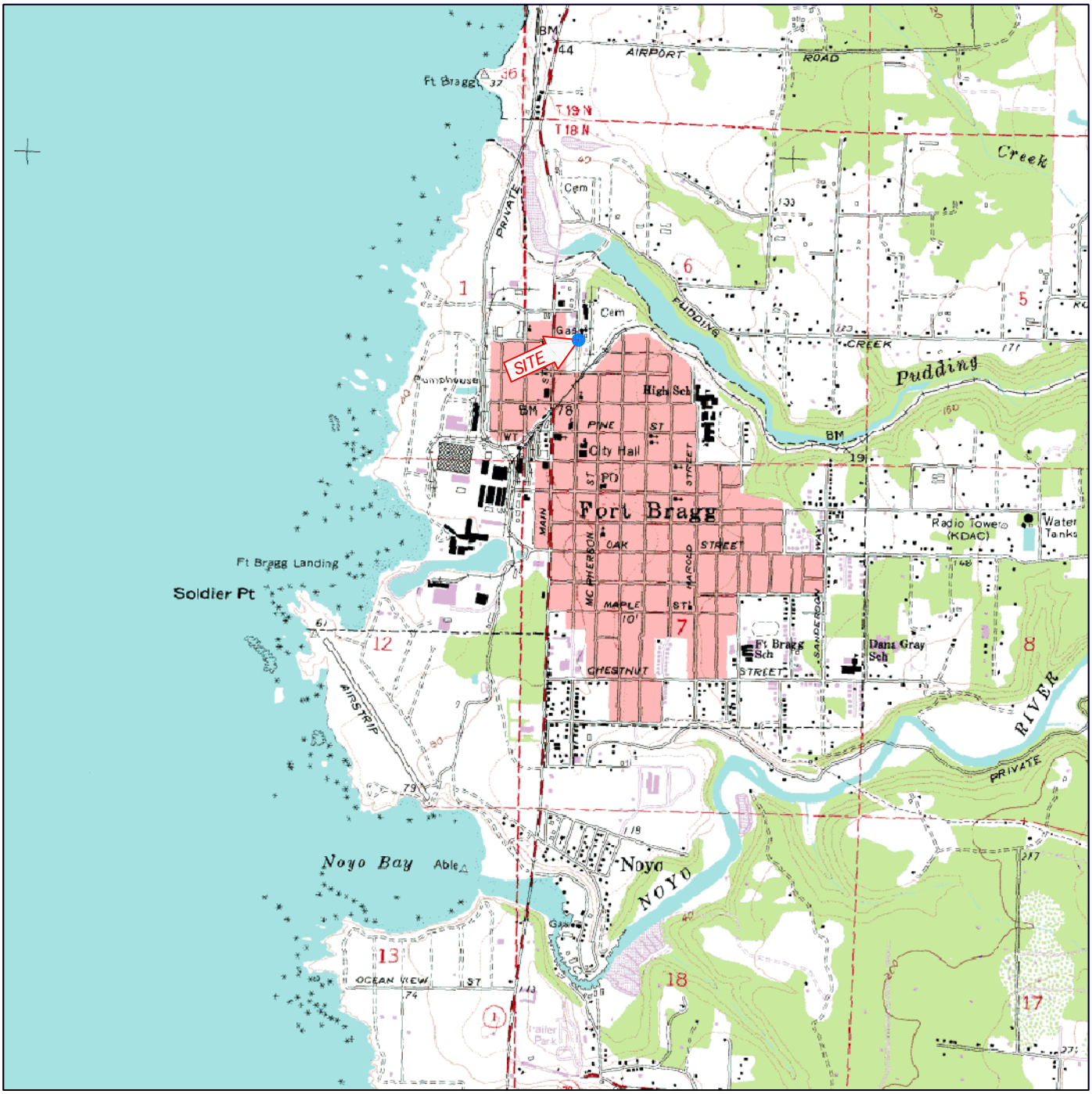
SHN Consulting Engineers & Geologists, Incorporated. 1999. Results of Site Investigation Former Unocal Bulk Plant #0220, North Franklin Street, Fort Bragg, California, Site ID #1NMCO48. September 28.

SHN Consulting Engineers & Geologists, Incorporated. 2000. Report of Findings for the Bioventing/Biosparging Treatability Study at the Former Unocal Bulk Plant #0220, 720 North Franklin Street, Fort Bragg, California. October 19.

SHN Consulting Engineers & Geologists, Incorporated. 2002. Work Plan for Bioventing/Ozone Sparging Remedial Action at the Former Unocal Bulk Plant #0220, 720 North Franklin Street, Fort Bragg, California. December 5.

SHN Consulting Engineers & Geologists, Incorporated. 2004. Remedial Action Implementation Report Former Unocal Bulk Plant #0220, 720 North Franklin Street, Fort Bragg, California. July 9.

FIGURES



North

CALIFORNIA

1 1/2 0 1

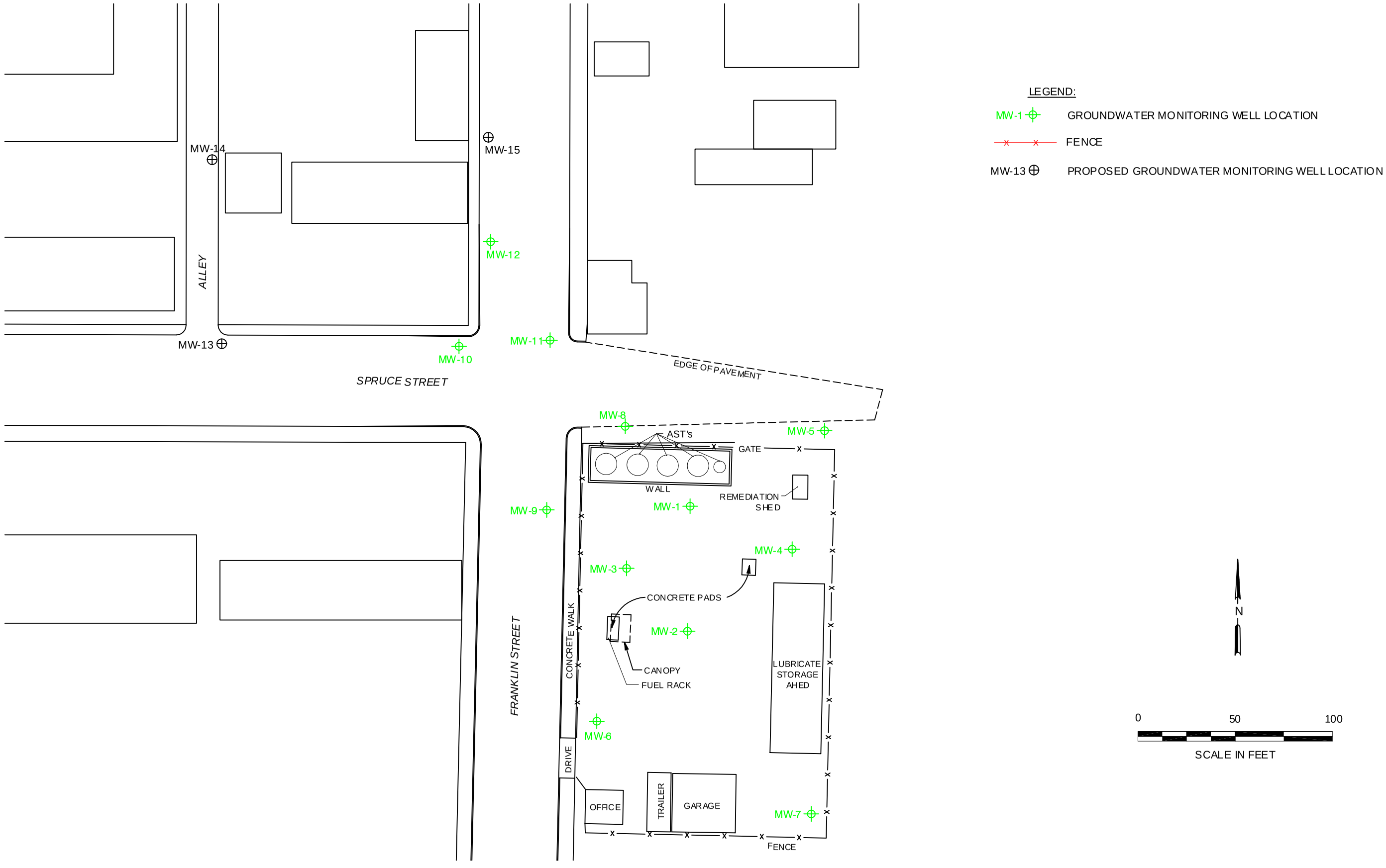
SCALE (MILES)

1000 0 1000 2000 3000 4000 5000 6000 7000

SCALE (FEET)

REFERENCE: USGS 7.5 MINUTE QUADRANGLE, FORT BRAGG, CALIFORNIA

SECOR 3017 KILGORE ROAD, SUITE 100 RANCHO CORDOVA, CALIFORNIA PHONE: (916) 861-0400/861-0430 (FAX)	FOR: CONOCOPHILLIPS BULK PLANT NO. 0220 20 NORTH FRANKLIN STREET FORT BRAGG, CALIFORNIA	**SITE LOCATION MAP**		FIGURE: **1**
JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:



REFERENCE: THIS FIGURE IS BASED ON A MAP PROVIDED BY MORROW SURVEYING

SECOR
3017 KILGORE ROAD, SUITE 100
RANCHO CORDOVA, CALIFORNIA
PHONE: (916) 861-0400/861-0430 (FAX)

FOR:
CONOCOPHILLIPS
BULK PLANT NO. 0220
720 NORTH FRANKLIN STREET
FORT BRAGG, CALIFORNIA

SITE PLAN

FIGURE: **2**

JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:
77CP.60927.06	DWR	TP	TP	7/31/06

ATTACHMENT 1
RWQCB-NCR LETTER DATED JUNE 15, 2006
Response to RWQCB-NCR Letter Dated June 15, 2006 and Work Plan for additional Site Assessment

Bulk Plant No. 0220
720 North Franklin Street
Fort Bragg, California
SECOR Project No.: 77CP.00927.06.1103

California Regional Water Quality Control Board
North Coast Region
William R. Massey, Chairman

Linda S. Adams
Agency Secretary

www.waterboards.ca.gov/northcoast
5550 Skylane Boulevard, Suite A, Santa Rosa, California 95403
Phone: (877) 721-9203 (toll free) • Office: (707) 576-2220 • FAX: (707) 523-0135

Arnold Schwarzenegger
Governor

June 15, 2006

Mr. Ed Ralston
ConocoPhilips
76 Broadway
Sacramento, CA 95818

Dear Mr. Ralston:

Subject: Site Status

File: Unocal Bulk Plant #0220, 720 North Franklin Street, Fort Bragg
Case No. 1NMC048

Regional Water Board staff received the *2005 Annual Summary and Monitoring Report* dated March 9, 2006. The annual report was submitted as required by Monitoring and Reporting Program No. R1-2003-0107 (Revised May 3, 2005). Regional Water Board staff has the following comments on the report.

- Monitoring and Reporting Program No. R1-2003-0107 requires that the annual report shall include all maintenance records for the entire year. The *2005 Annual Summary and Monitoring Report* did not contain these records. By July 3, 2006, please submit all remediation system maintenance records for 2005.

- According to the annual report ozone system operation summary, the ozone sparge system has not been operating since May 2005 due to various mechanical failures. Continued non-operation of the system is unacceptable. By August 1, 2006, please provide documentation that the system is operating. If it is found that the system is damaged beyond repair, then recommendations must be provided to address future remedial actions at the site including replacement of the ozone system or selecting an alternative remedial option.

- The annual report provides recommendations to conduct additional site assessment to fully define the extent of contamination. Regional Water Board staff concurs with this recommendation. By August 1, 2006, please submit a workplan to propose this next scope of work.

JUN 1 9 2006

ORIGINAL

Notice of Violation

Regional Water Board staff received the January 24, 2005 *Quarterly Summary and Monitoring Report-Fourth Quarter 2005*. Quarterly monitoring activities took place on November 3, 2005. Samples from monitoring wells MW-8 and MW-11 were not analyzed for total petroleum hydrocarbons as diesel as required by Monitoring and Reporting Program No. R1-2003-0107. Continued violations of the Monitoring and Reporting Program will result in further enforcement actions.

Additional Monitoring Requirements

The North Coast Regional Water Board now has additional monitoring requirements for facilities using ozone as an in-situ remedial technology. In addition to the current monitoring requirements, monitoring wells MW-1, MW-2, MW-3, MW-4, MW-8 and MW-11 shall be sampled quarterly for the following parameters: bromide, bromate (reporting limit shall be no higher than 10 µg/L), dissolved hexavalent chromium (reporting limit shall be no higher that 5 µg/L), dissolved vanadium, dissolved selenium, and dissolved molybdenum. Accordingly, enclosed is Monitoring and Reporting Program No. R1-2006-0063. Please implement this program beginning with third quarter 2006 monitoring activities.

Additionally, the Regional Water Board requires the collection of background samples for these parameters. Collection of the background sample must also take place during the third quarter 2006 monitoring event. Monitoring well MW-7 has been previously determined to be an up-gradient well, and would be an acceptable background sampling location.

Closing

In summary, please submit the following:

- By July 3, 2006 please submit all remediation system maintenance records for 2005.
- By August 1, 2006 documentation that the ozone system is operational,
- Also by August 1, 2006 a workplan to propose a scope of work to define the extent of contamination, and
- Implement Monitoring and Reporting Program No. R1-2006-0063 during the third quarter of 2006.

If you have any questions, please contact me at (707) 576-2831.

Sincerely,

Colleen Hunt
Environmental Scientist

CHH:clh/061506_CHH_ubp_status

cc: TRC, 21 Technology Drive, Irvine, CA 94618
Mr. David Smith, Mendocino County Coast Petroleum Inc., 720 North Franklin Avenue, Fort Bragg, CA 95437
Mr. Thomas Potter, SECOR International, Inc., 3017 Kilgore Road, Suite 100, Rancho Cordova, CA 95670
Mendocino County Health Department

California Regional Water Quality Control Board
North Coast Region

Monitoring and Reporting Program No. R1-2006-0063
(Replacing Monitoring and Reporting Program No. R1-2003-0107)

for

ConocoPhilips
Unocal Bulk Plant #0220 (Former)
720 North Franklin Street
Fort Bragg, California

Mendocino County

MONITORING

1. The depth to groundwater in all monitoring wells shall be determined to at least 0.01 foot increments quarterly. The data generated from the elevation readings must be referenced to mean sea level.

2. Groundwater in each monitoring well shall be monitored quarterly for dissolved oxygen, dissolved carbon dioxide, oxidation-reduction potential, pH, temperature, and conductivity.

3. Headspace in each monitoring well shall be monitored quarterly using field instruments to measure percent oxygen, percent carbon dioxide, and organic vapor.

4. Groundwater in each monitoring well shall be sampled according to Table 1 (Attached). The analyses shall be performed by a state certified laboratory for total petroleum hydrocarbons as gasoline (TPH-g), total petroleum hydrocarbons as diesel (TPH-d), benzene, toluene, ethylbenezene, xylene (collectively identified as BTEX), methyl tertiary butyl ether (MTBE), dissolved methane, dissolved iron, dissolved manganese, nitrate, and sulfate (collectively identified as ADDITIONAL).

5. Groundwater monitoring wells MW-1, MW-2, MW-3, MW-4, MW-8 and MW-11 shall be sampled quarterly for the following parameters: bromide, bromate (reporting limit shall be no higher than 10 µg/L), dissolved hexavalent chromium (reporting limit shall be no higher that 5 µg/L), dissolved vanadium, dissolved selenium, and dissolved molybdenum.

REPORTING

1. The following maps shall be submitted with each quarterly monitoring report:

   a. A map of the facility showing the quarterly groundwater flow pattern, including the direction of the groundwater gradient and the location of all monitoring wells, and

   b. A map of the facility showing the quarterly chemical concentrations.

2. The results of each quarter's elevation shall be reported in a tabular form indicating the surveyed elevations of each reference point, depth to groundwater from the reference point, and the actual groundwater elevation.

3. Sampling analytical and monitoring data from each quarter shall be summarized in tabular form, including all previously generated sampling data.

4. Monitoring reports shall be submitted to the Regional Water Board at a quarterly frequency. Monitoring reports shall be prepared by or under the supervision of a California Registered Engineer or Geologist. Monitoring reports shall be submitted to this office in accordance with the following schedule:

Reporting Period	**Due Date**
January, February, March (1st Quarter)	April 30
April, May, June (2nd Quarter)	July 30
July, August, September (3rd Quarter)	October 30
October, November, December (4th Quarter)	January 30

5. All monitoring reports, data, and depth to groundwater measurement shall also be submitted electronically to the State Water Resources Control Board's Geographic Environmental Information Management System database (GeoTracker) as required by Title 23, Division 3, Chapter 16, Article 12 of the California Code of Regulations (i.e., AB2886 electronic reporting requirements)[1]

6. An annual report shall be submitted to the Regional Water Board by January 30 of each year. The annual report serves as a document to evaluate data generated throughout each calendar year. This report needs to include a full evaluation of all data generated throughout the year, including concentration trend evaluation for all analyses performed, evaluation of all indicator parameters in terms of remedial effectiveness, conditions of the remedial system, and an overall evaluation of the effectiveness of the active remedial system.

7. The annual report shall also include all maintenance and operations records for the entire year. Records should include date of inspections, parameters measured, summary of visual observations made, and changes made to the operating system.

Ordered by

Catherine Kuhlman

Catherine Kuhlman
Executive Officer

June 15, 2006

061506_UBP_M&R_revised

[1] Information on AB2886 electronic reporting can be obtained on the Internet by following the Electronic Submittal of Information link on the GeoTracker home page at http://geotracker.waterboards.ca.gov/.

Table 1

Well ID	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
MW-1	TPH-g, TPH-d, BTEX, MTBE		TPH-g, TPH-d, BTEX, MTBE	
MW-2	TPH-g, TPH-d, BTEX, MTBE		TPH-g, TPH-d, BTEX, MTBE	
MW-3	TPH-g, TPH-d, BTEX, MTBE		TPH-g, TPH-d, BTEX, MTBE	
MW-4	TPH-g, TPH-d, BTEX, MTBE, ADDITIONAL	TPH-g, TPH-d, BTEX, MTBE	TPH-g, TPH-d, BTEX, MTBE, ADDITIONAL	TPH-g, TPH-d, BTEX, MTBE
MW-5	TPH-g, TPH-d, BTEX, MTBE		TPH-g, TPH-d, BTEX, MTBE	
MW-6	TPH-g, TPH-d, BTEX, MTBE			
MW-7	TPH-g, TPH-d, BTEX, MTBE			
MW-8	TPH-g, TPH-d, BTEX, MTBE	TPH-g, TPH-d	TPH-g, TPH-d, BTEX, MTBE	TPH-g, TPH-d
MW-9	TPH-g, TPH-d, BTEX, MTBE			
MW-10	TPH-g, TPH-d, BTEX, MTBE, ADDITIONAL		TPH-g, TPH-d, BTEX, MTBE, ADDITIONAL	
MW-11	TPH-g, TPH-d, BTEX, MTBE, ADDITIONAL	TPH-g, TPH-d	TPH-g, TPH-d, BTEX, MTBE, ADDITIONAL	TPH-g, TPH-d
MW-12	TPH-g, TPH-d, BTEX, MTBE, ADDITIONAL		TPH-g, TPH-d, BTEX, MTBE, ADDITIONAL	

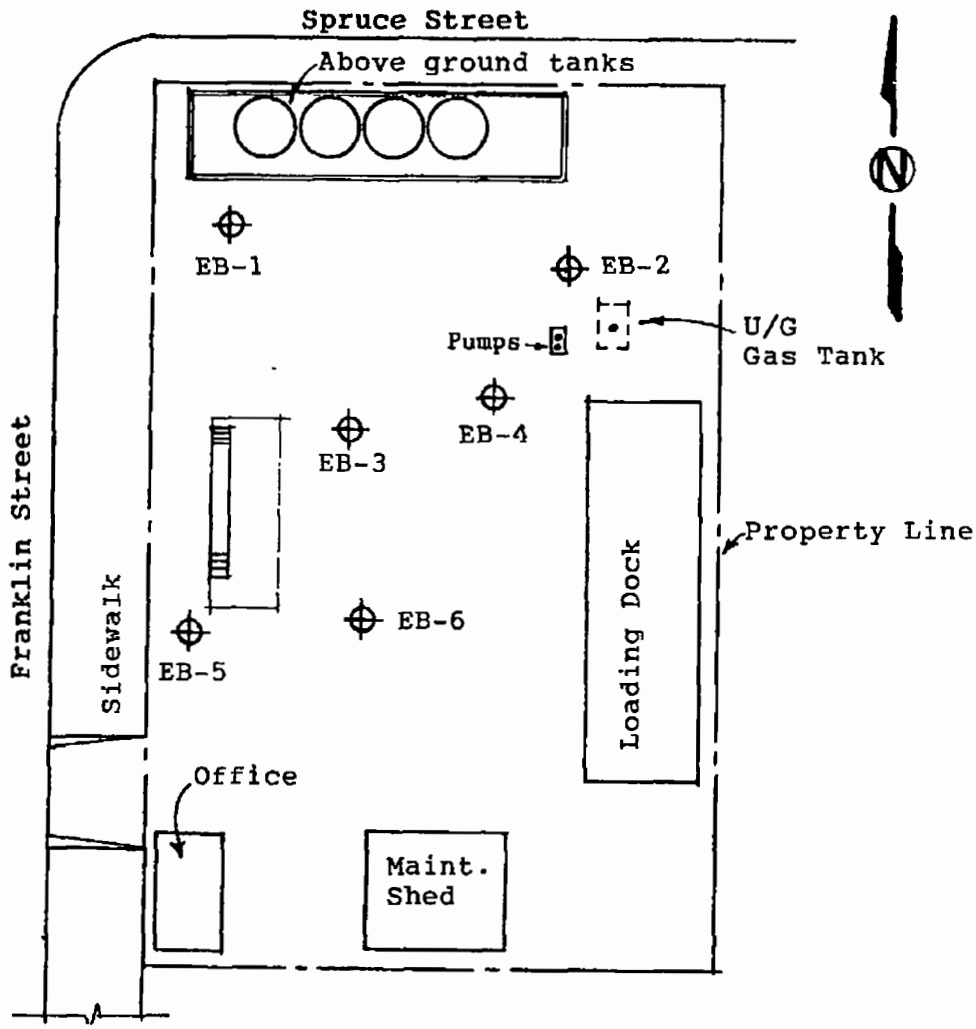
ATTACHMENT 2
TABLES AND MAPS FROM PREVIOUS REPORTS BY KEI (OCTOBER 18, 1988; MARCH 1, 1989; APRIL 21, 1989; AUGUST 30, 1989 AND NOVEMBER 29, 1995), PEG (FEBRUARY 1998); SHN (SEPTEMBER 9, 1998; SEPTEMBER 28, 1999; OCTOBER 19, 2000 AND JULY 9, 2004)

Response to RWQCB-NCR Letter Dated June 15, 2006 and Work Plan for additional Site Assessment

Bulk Plant No. 0220
720 North Franklin Street
Fort Bragg, California
SECOR Project No.: 77CP.00927.06.1103

(KEI, 1988)

KAPREALIAN ENGINEERING, INC.
Consulting Engineers
P. O. BOX 913
BENICIA, CA 94510
(415) 676-9100 (707) 746-6915



LOCATION PLAN

0 40 80
Approx. Scale

⊕ Exploratory Boring

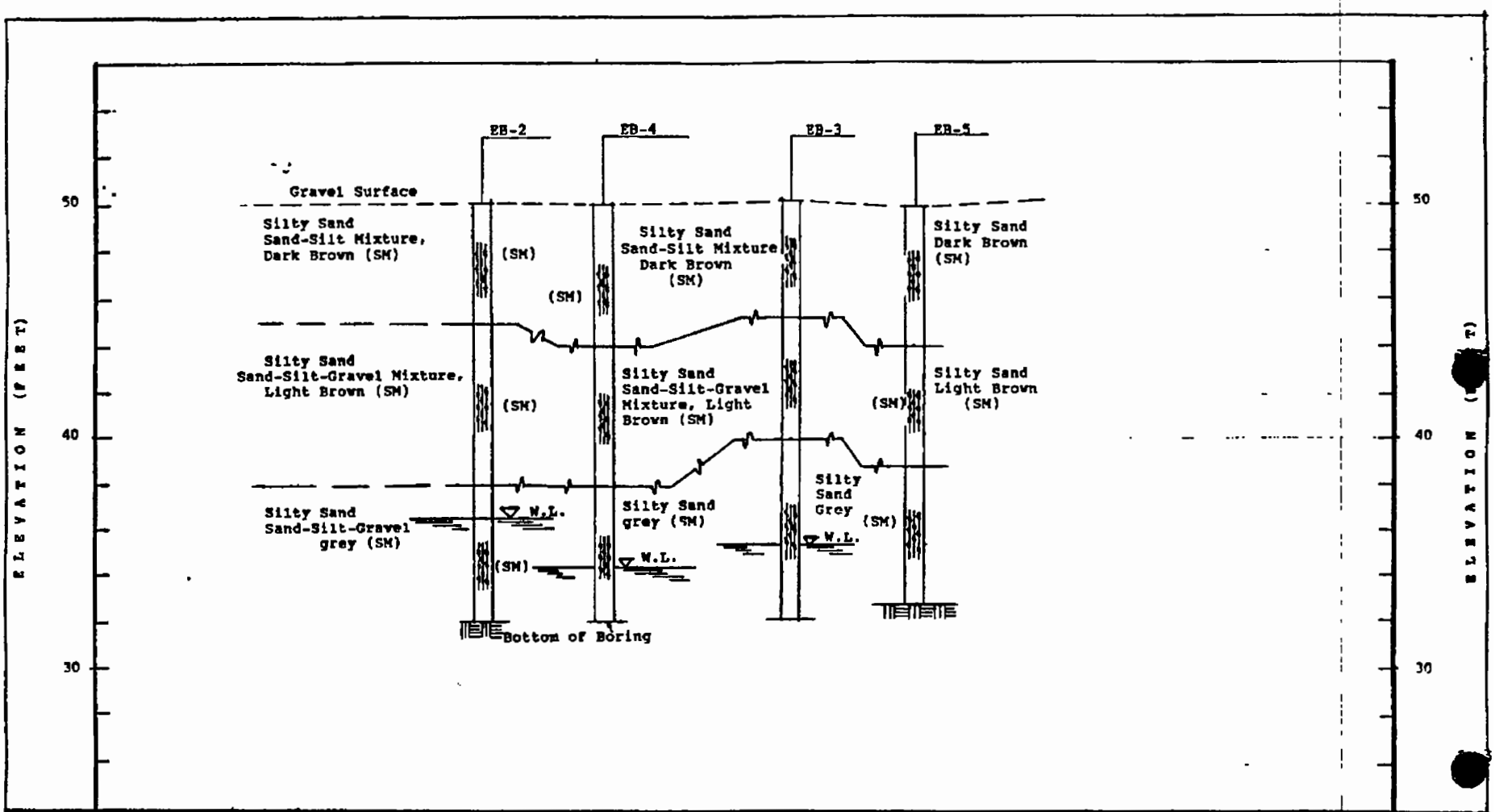
Unocal Bulk Plant
720 N. Franklin Street
Fort Bragg, California

TABLE - 1

Sample Number	Total Petroleum Hydrocarbons	Benzene	Toluene	Xylene	Ethyl-benzene
EB1(5')	ND	ND	ND	ND	ND
EB1(10')	ND	ND	ND	ND	ND
EB1(15')	98	ND	ND	0.26	0.19
EB2(5')	ND	ND	ND	ND	ND
EB2(10')	ND	ND	ND	ND	ND
EB2(15')	160	ND	0.13	1.3	0.56
EB3(5')	ND	ND	ND	ND	ND
EB3(10')	1.7	ND	ND	ND	ND
EB3(15')	80	ND	ND	ND	ND
EB4(5')	2.3	ND	ND	ND	ND
EB4(10')	ND	ND	ND	ND	ND
EB4(15')	6.0	ND	ND	ND	ND
EB5(5')	ND	ND	ND	ND	ND
EB5(10')	ND	ND	ND	ND	ND
EB5(15')	1.2	ND	ND	ND	ND
EB6(5')	ND	ND	ND	ND	ND
EB6(15')	340	ND	ND	ND	0.61

Results of Water Analyses - parts per billion

Sample Number	Total Petroleum Hydrocarbons	Benzene	Toluene	Xylene	Ethyl-benzene
EB1	ND	ND	ND	ND	ND
EB2	8000	8.1	5.2	200	28
EB3	130	ND	2.1	1.9	0.52
EB4	380	ND	ND	0.95	ND



Vertical
0 4 8 feet
Horizontal
0 20 40 feet

L E G E N D

Silty Sand

KAPREALIAN ENGINEERING, INC.
P. O. Box 913
Benicia, CA 94510

UNOCAL MARKETING STATION
720 N. Franklin Street
Fort Bragg, California

SUBSURFACE PROFILE

(KEI, 1989c)

KEI-P88-0904.R2
March 1, 1989

TABLE 2

SUMMARY OF LABORATORY ANALYSES
SOIL

(Results in ppm)
(Collected on January 23, 1989)

Sample Number	Depth (feet)	TPH as Gasoline	Benzene	Toluene	Xylenes	Ethylbenzene
MW-1	5.50	<1.0	<0.05	<0.1	<0.1	<0.1
MW-1	10.00	<1.0	<0.05	<0.1	<0.1	<0.1
MW-1	13.25	47	<0.05	<0.1	0.26	<0.1
MW-2	5.25	1.1	<0.05	<0.1	0.26	<0.1
MW-2	10.25	<1.0	<0.05	<0.1	0.26	<0.1
MW-3	5.25	<1.0	<0.05	<0.1	0.26	<0.1
MW-3	10	<1.0	<0.05	<0.1	0.26	<0.1
MW-3	15.25	5.1	<0.05	<0.1	0.26	<0.1
MW-4	10.25	790	<0.05	0.76	8.8	2.9
MW-4	15.25	1.5	<0.05	<0.1	<0.1	<0.1

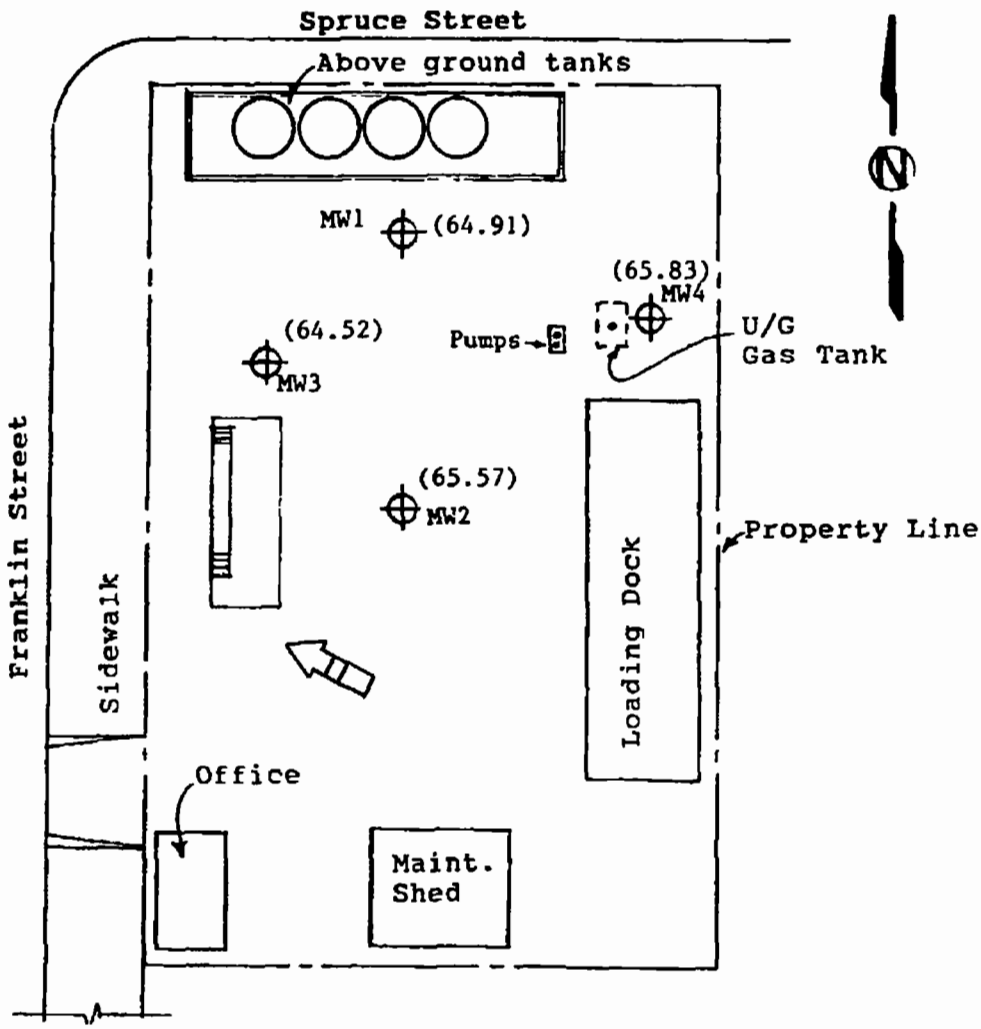
SUMMARY OF LABORATORY ANALYSES
WATER

(Results in ppb)
(Collected on February 7, 1989)

Sample Number	Depth (feet)	TPH as Gasoline	TPH as Diesel	Benzene	Toluene	Xylenes	Ethyl-benzene
MW-1	11.42	4,900	120,000	31	12	53	26
MW-2*	11.42	2,800	1,900	4.1	<0.1	7.4	<0.1
MW-3	11.38	7,700	8,100	7.1	1.6	9.7	1.9
MW-4	12.54	8,800	160,000	87	3.9	280	39

*TOG for this sample was 350 ppm.

KAPREALIAN ENGINEERING, INC.
Consulting Engineers
P. O. BOX 913
BENICIA, CA 94510
(415) 676-9100 (707) 746-6915



SITE PLAN

0 40 80
Approx. Scale

Monitoring Well

( ) Water Table Elevation (MSL) on 2/6/89

Ground Water Flow Direction on 2/6/89

Unocal Bulk Plant
720 N. Franklin Street
Fort Bragg, California

(KEI, 1989b)

KEI-P88-0904.R3
April 21, 1989

TABLE 2

SUMMARY OF LABORATORY ANALYSES
SOIL

(Results in ppm)
(Collected on March 29, 1989)

Sample Number	Depth (feet)	TPH as Gasoline	TPH as Diesel	Benzene	Toluene	Xylenes	Ethyl-benzene
MW5	5	ND	ND	ND	ND	ND	ND
MW5	10	1.1	ND	ND	ND	ND	ND
MW5	15	ND	ND	ND	ND	ND	ND
MW6	5	ND	ND	0.20	ND	ND	ND
MW6	10	ND	ND	ND	ND	ND	ND
MW7	5	ND	ND	ND	ND	ND	ND
MW7	9.5	ND	ND	ND	ND	ND	ND
MW8	5	ND	ND	ND	ND	ND	ND
MW8	9	ND	ND	ND	ND	ND	ND
MW9	5	ND	ND	ND	ND	ND	ND
MW9	9	ND	ND	ND	ND	ND	ND
Detection Limits		1.0	1.0	0.05	0.1	0.1	0.1

SUMMARY OF LABORATORY ANALYSES
WATER

(Results in ppb)
(Collected on April 1, 1989)

Sample Number	TPH as Gasoline	TPH as Diesel	Benzene	Toluene	Xylenes	Ethyl-benzene
MW5	ND	ND	ND	ND	ND	ND
MW6	ND	400	ND	ND	ND	ND
MW7	130	390	1.1	ND	ND	ND
MW8	1,700	77,000	ND	ND	ND	ND
MW9	ND	ND	ND	ND	ND	ND
Detection Limits	50	50	0.5	0.5	0.5	0.5

ND = Non-detectable.

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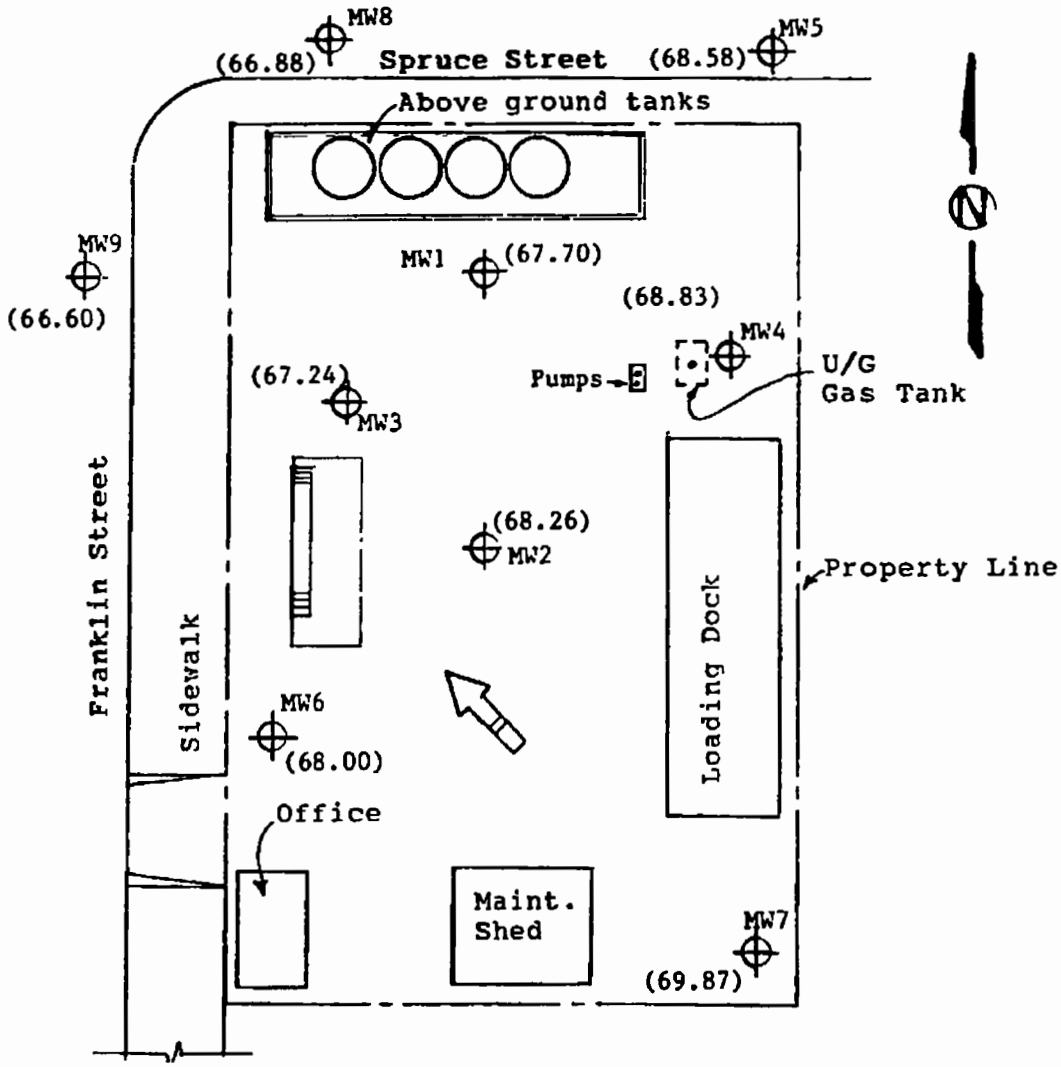
Consulting Engineers
P O BOX 913
BENICIA, CA 94510
(415) 676-9100 (707) 746-6915



SITE PLAN
Figure 1

0 40 80
Approx. Scale

⊕ Monitoring Well

( ) Water Table Elevation on 4/1/89 (MSL)

⇨ Ground Water Flow Direction on 4/1/89

Unocal Bulk Plant
720 N. Franklin Street
Fort Bragg, California

(KEI, 1989c)

KEI-P88-0904.R4
August 30, 1989

TABLE 2

SUMMARY OF LABORATORY ANALYSES
SOIL

(Results in ppm)
(Collected on July 26, 1989)

Sample Number	Depth (feet)	TPH as Diesel	TPH as Gasoline	Benzene	Toluene	Xylenes	Ethyl-benzene
MW10	5	ND	ND	ND	ND	ND	ND
MW10	10	ND	ND	ND	ND	ND	ND
MW10	12	ND	ND	ND	ND	ND	ND
MW11	5	ND	ND	ND	ND	ND	ND
MW11	7	ND	ND	ND	ND	ND	ND
MW11	9	ND	ND	ND	ND	ND	ND
MW11	13	120	31	ND	ND	ND	ND
Detection Limits		1.0	1.0	0.05	0.1	0.1	0.1

ND = Non-detectable.

KEI-P88-0904.R4
August 30, 1989

TABLE 3

SUMMARY OF LABORATORY ANALYSES
WATER

(Results in ppb)
(Collected on August 3, 1989)

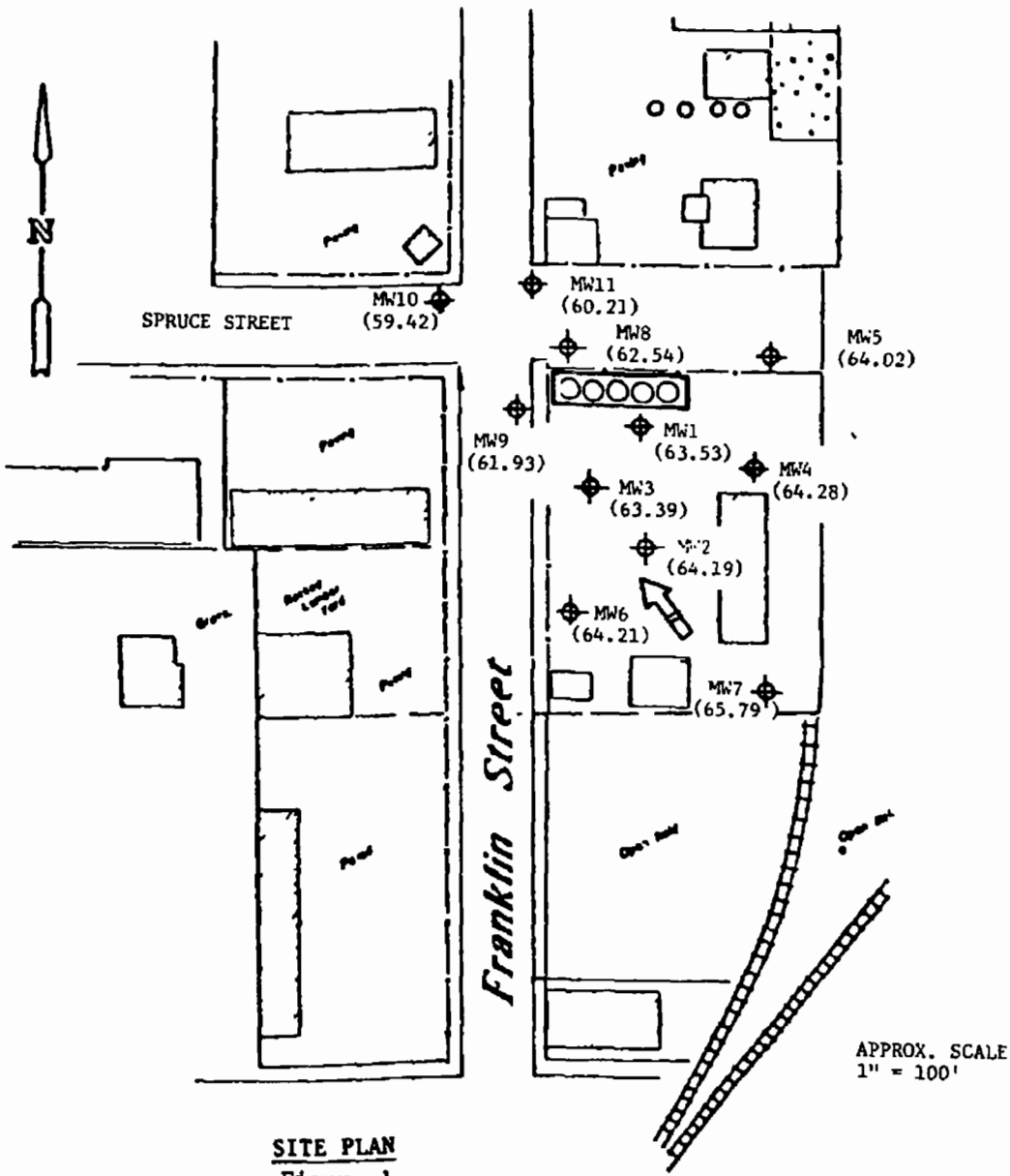
Sample Number	Depth (feet)	TPH as Diesel	TPH as Gasoline	Benzene	Toluene	Xylenes	Ethyl-benzene
MW1	13.88	5,000	270	ND	ND	ND	ND
MW2*	13.74	4,800	74	ND	ND	ND	ND
MW3	14.48	3,500	490	ND	ND	ND	ND
MW4	14.93	50,000	3,300	ND	ND	ND	ND
MW5	16.30	ND	ND	ND	ND	ND	ND
MW6	12.27	ND	ND	ND	ND	ND	ND
MW7	12.67	ND	54	1.4	0.93	0.35	0.71
MW8	12.58	1,900	1,600	ND	ND	ND	ND
MW9	11.81	ND	ND	ND	ND	ND	ND
MW10	13.17	180	61	ND	ND	ND	ND
MW11	14.10	540	77	ND	ND	ND	ND
(Collected on April 1, 1989)							
MW5	11.66	ND	ND	ND	ND	ND	ND
MW6	8.76	400	ND	ND	ND	ND	ND
MW7	8.51	390	130	1.1	ND	ND	ND
MW8	8.20	77,000	1,700	ND	ND	ND	ND
MW9	5.12	ND	ND	ND	ND	ND	ND
(Collected on February 7, 1989)							
MW1	11.42	120,000	4,900	31	12	53	26
MW2**	11.42	1,900	2,800	4.1	ND	7.4	ND
MW3	11.38	8,100	7,700	7.1	1.6	9.7	1.9
MW4	12.54	160,000	8,800	87	3.9	280	39
Detection Limits		50	30	0.3	0.3	0.3	0.3

ND = Non-detectable.

* TOG was non-detectable for this sample.

** TOG for this sample was 350 ppm.

KAPREALIAN ENGINEERING, INC.
Consulting Engineers
P O BOX 913
BENICIA CA 94510
(707) 746 6915



SITE PLAN
Figure 1

⌖ Monitoring Well
( ) Ground Water Elevation in feet (MSL)
⇨ Direction of Ground Water Flow

Unocal Marketing Station
720 N. Franklin Street
Fort Bragg, California

(KEI, 1995)

KEI-P88-0904.R6
November 29, 1995

TABLE 3

SUMMARY OF LABORATORY ANALYSES
SOIL

Date	Sample Number	Depth (feet)	TPH as Diesel	TPH as Gasoline	Benzene	Toluene	Ethyl-benzene	Xylenes
1/23/89	MW1	5.50	--	ND	ND	ND	ND	ND
	MW1	10.00	--	ND	ND	ND	ND	ND
	MW1	13.25	--	47	ND	ND	ND	0.26
	MW2	5.25	--	1.1	ND	ND	ND	0.26
	MW2	10.25	--	ND	ND	ND	ND	0.26
	MW3	5.25	--	ND	ND	ND	ND	0.26
	MW3	10.0	--	ND	ND	ND	ND	0.26
	MW3	15.25	--	5.1	ND	ND	ND	0.26
	MW4	10.25	--	790	ND	0.76	2.9	8.8
	MW4	15.25	--	1.5	ND	ND	ND	ND
3/29/89	MW5	5.0	ND	ND	ND	ND	ND	ND
	MW5	10.0	1.1	ND	ND	ND	ND	ND
	MW5	15.0	ND	ND	ND	ND	ND	ND
	MW6	5.0	ND	ND	0.20	ND	ND	ND
	MW6	10.0	ND	ND	ND	ND	ND	ND
	MW7	5.0	ND	ND	ND	ND	ND	ND
	MW7	9.5	ND	ND	ND	ND	ND	ND
	MW8	5.0	ND	ND	ND	ND	ND	ND
	MW8	9.0	ND	ND	ND	ND	ND	ND
	MW9	5.0	ND	ND	ND	ND	ND	ND
	MW9	9.0	ND	ND	ND	ND	ND	ND
7/26/89	MW10	5.0	ND	ND	ND	ND	ND	ND
	MW10	10.0	ND	ND	ND	ND	ND	ND
	MW10	12.0	ND	ND	ND	ND	ND	ND
	MW11	5.0	ND	ND	ND	ND	ND	ND
	MW11	7.0	ND	ND	ND	ND	ND	ND
	MW11	9.0	ND	ND	ND	ND	ND	ND
	MW11	13.0	120	31	ND	ND	ND	ND
9/01/95	MW12	5.0	ND	ND	ND	ND	ND	ND
	MW12	10.0	ND	ND	ND	ND	ND	ND
	MW12	13.0	ND	ND	ND	ND	ND	ND
	MW12	18.5	ND	ND	ND	ND	ND	ND

TABLE 3 (Continued)

SUMMARY OF LABORATORY ANALYSES
SOIL

-- Indicates analysis was not performed.

ND = Non-detectable.

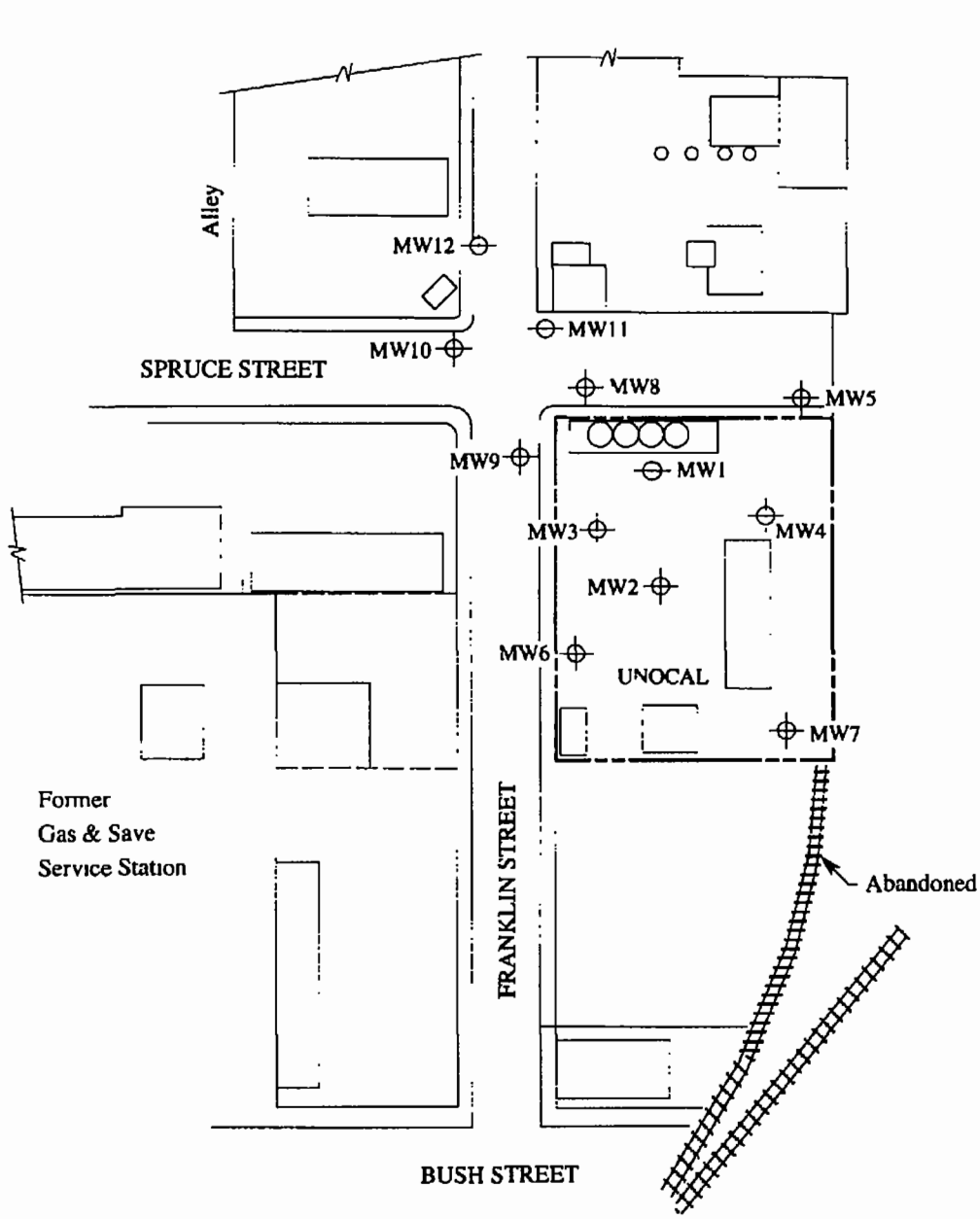
Results are in parts per million (ppm), unless otherwise indicated.

KEI-P88-0904.R6
November 29, 1995

TABLE 4

SUMMARY OF LABORATORY ANALYSES
WATER

Date	Well #	TPH as Diesel	TPH as Gasoline	Benzene	Toluene	Ethyl-benzene	Xylenes
11/08/95	MW12	220▼	430	7.2	51	12	94
8/22/95	MW1	95	120	ND	ND	ND	0.65
	MW2	ND	ND	ND	ND	ND	ND
	MW3	ND	ND	ND	ND	ND	ND
	MW4	48,000	18,000♦	ND	ND	22	24
	MW5	ND	150♦	ND	ND	ND	ND
	MW6	ND	ND	ND	ND	ND	ND
	MW7	ND	ND	ND	ND	ND	ND
	MW8	20,000	1,000,000♦	ND	ND	ND	ND
	MW9	ND	ND	ND	ND	ND	ND
	MW10▲▲	90	ND	ND	ND	ND	ND
	MW11▲▲	560	150♦	ND	ND	ND	ND
2/10/95	MW1	190▼▼	110	ND	ND	0.66	ND
	MW2	ND	ND	ND	ND	ND	ND
	MW3	ND	ND	ND	ND	ND	ND
	MW4	38,000	81,000♦	ND	ND	ND	ND
	MW5	ND	ND	ND	ND	ND	ND
	MW6	ND	ND	ND	ND	ND	ND
	MW7	ND	ND	ND	ND	ND	ND
	MW8	210,000	160,000♦	ND	ND	ND	ND
	MW9	91▼	ND	ND	ND	ND	ND
	MW10	77▼	ND	ND	ND	ND	ND
	MW11	2,100▼▼	100♦	ND	ND	ND	ND
9/14/94	MW1	80▼	ND	ND	1.3	ND	1.0
	MW2	70▼	ND	ND	1.4	ND	1.2
	MW3	85▼	ND	ND	1.4	ND	1.4
	MW4	18,000	3,400♦♦	ND	19	ND	27
	MW5	90▼	ND	ND	1.1	ND	1.1
	MW6	82▼	ND	ND	1.6	ND	1.3
	MW7	130▼	ND	ND	1.2	ND	1.2
	MW8	NOT SAMPLED DUE TO THE PRESENCE OF FREE PRODUCT					
	MW9	110▼	ND	ND	0.79	ND	0.78
	MW10	200	ND	ND	0.75	ND	1.3
	MW11	15,000	1,000♦	ND	ND	ND	ND



LEGEND

⊖ Monitoring well

0 100 200

Approx scale feet

MONITORING WELL LOCATION MAP

KAPREALIAN ENGINEERING
INCORPORATED

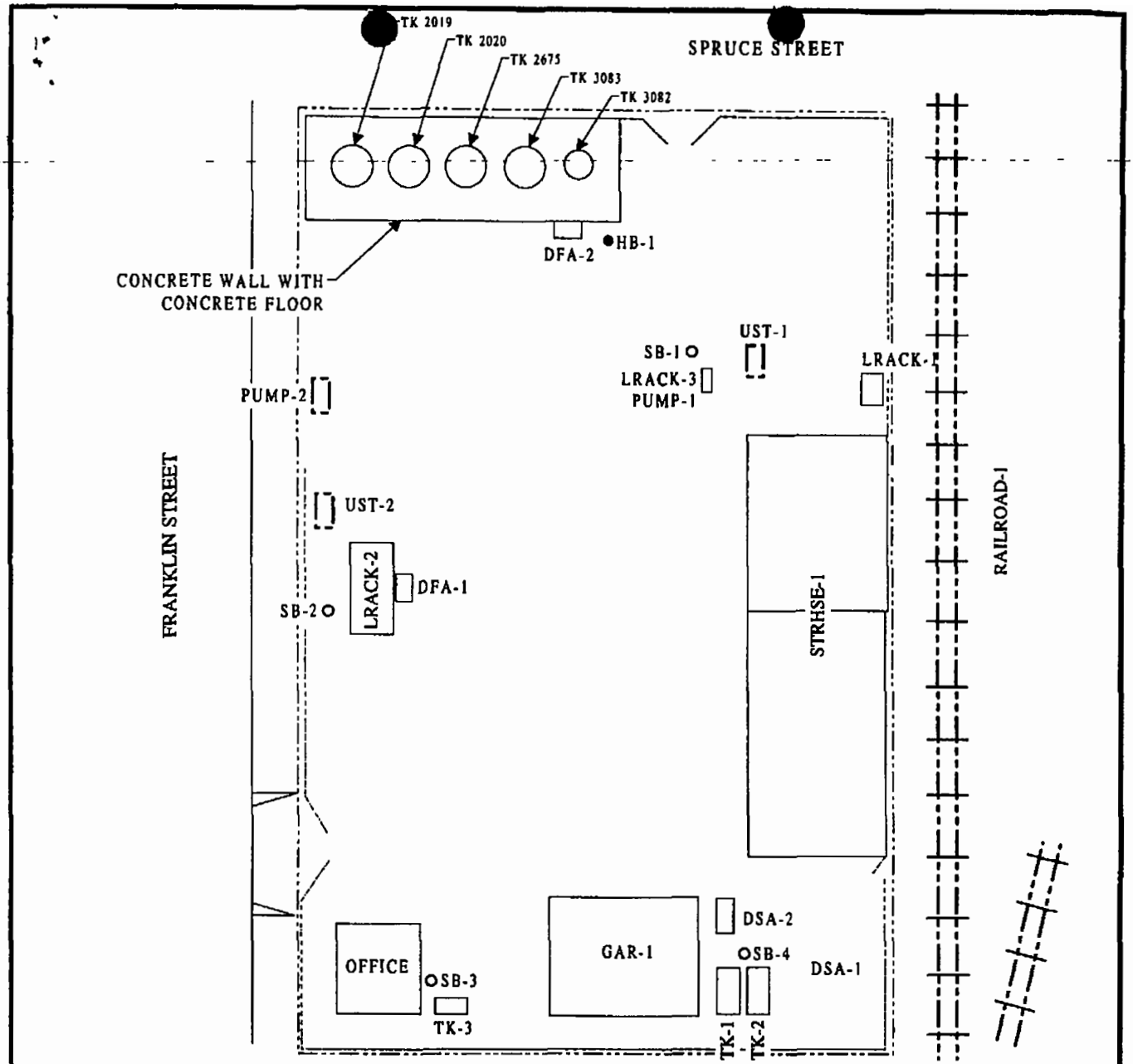
UNOCAL BULK PLANT #0220
720 N. FRANKLIN STREET
FORT BRAGG, CALIFORNIA

FIGURE
1

Table 1
Summary of Soil Analytical Results
Tosco Bulk Plant No. 0220
Ft. Bragg, California

Sample Name	Sample Date	Sample Depth (ft)	EPA Method 8015M			EPA Method 8020				8270	8080
			TPH-g	TPH-d	TPH-o	Benzene	Toluene	Ethyl-benzene	Total Xylenes	PAHs	PCBs
Soil Samples (mg/Kg)											
HA-1-5'	9/25/97	5	**34**	*nd*	**16**	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*
SB-1-5'	9/25/97	5	**37**	**28**	*nd*	*nd*	*nd*	*nd*	*nd*	—	—
SB-2-15'	9/25/97	15	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	—	—
SB-3-5'	9/25/97	5	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	—	—
SB-4-15'	9/25/97	15	**2.0**	**4.0**	*nd*	*nd*	*nd*	*nd*	*nd*	—	—

NOTES
nd = Not detected (See Lab Report for Detection Limits) — = Not analyzed mg/Kg = milligrams per kilogram µg/L = micrograms per liter
TPH-g = Total petroleum hydrocarbons as gasoline TPH-d = Total petroleum hydrocarbons as diesel TPH-o = Total petroleum hydrocarbons as oil
PAHs = Polynuclear Aromatic Hydrocarbons PCBs = Polychlorinated Biphenyls



LEGEND

SB-1 ○ SOIL BORING LOCATION AND DESIGNATION

HB-1 ● HAND BORING LOCATION AND DESIGNATION

N

APPROXIMATE SCALE 1" = 40'

PACIFIC ENVIRONMENTAL GROUP, INC	**SITE MAP** **TOSCO CORPORATION** 76 Products Company Bulk Plant No 0220 720 North Franklin Ft Bragg, California	Revision Date **0220**

AREAS OF CONCERN LOCATION MAP
KEY TO ABBREVIATIONS

DFA - Drum filling area
DISPEN - Dispensers
DITCH - Ditch or creek
DSA - Drum storage area
DRYWELL - Dry well
FILL - Fill area
GAR - Garage
GASTTN - Gas station
HWSA - Hazardous waste storage area
IMPND - Impoundment
LAYDOWN - Laydown
LRACK - Loading rack
MAINT - Maintenance area
MARACK - Marine loading rack
OUTFALL - Outfall
OWS - Oil/Water separator
PUMP - Pump
RAILROAD - Railroad
SEPTIC - Septic tank or cess pool
SPILL - Spill site
STRHSE - Storehouse
SUMP - Sump
TK - Aboveground tank
TRANS - Transformer
UST - Underground tank
VACANT - Vacant
WELL - Drinking water well
WSHDWN - Wash down rack
WWTP - Waste water treatment plant

Not typically shown on maps:
ABPIPE - Aboveground product piping
SBSRFC - Subsurface soil and groundwater
SEWER - Sewer piping
UNPIPE - Underground product piping

Note. 4 digit tank numbers correspond to 76 Products designations.

LEGEND

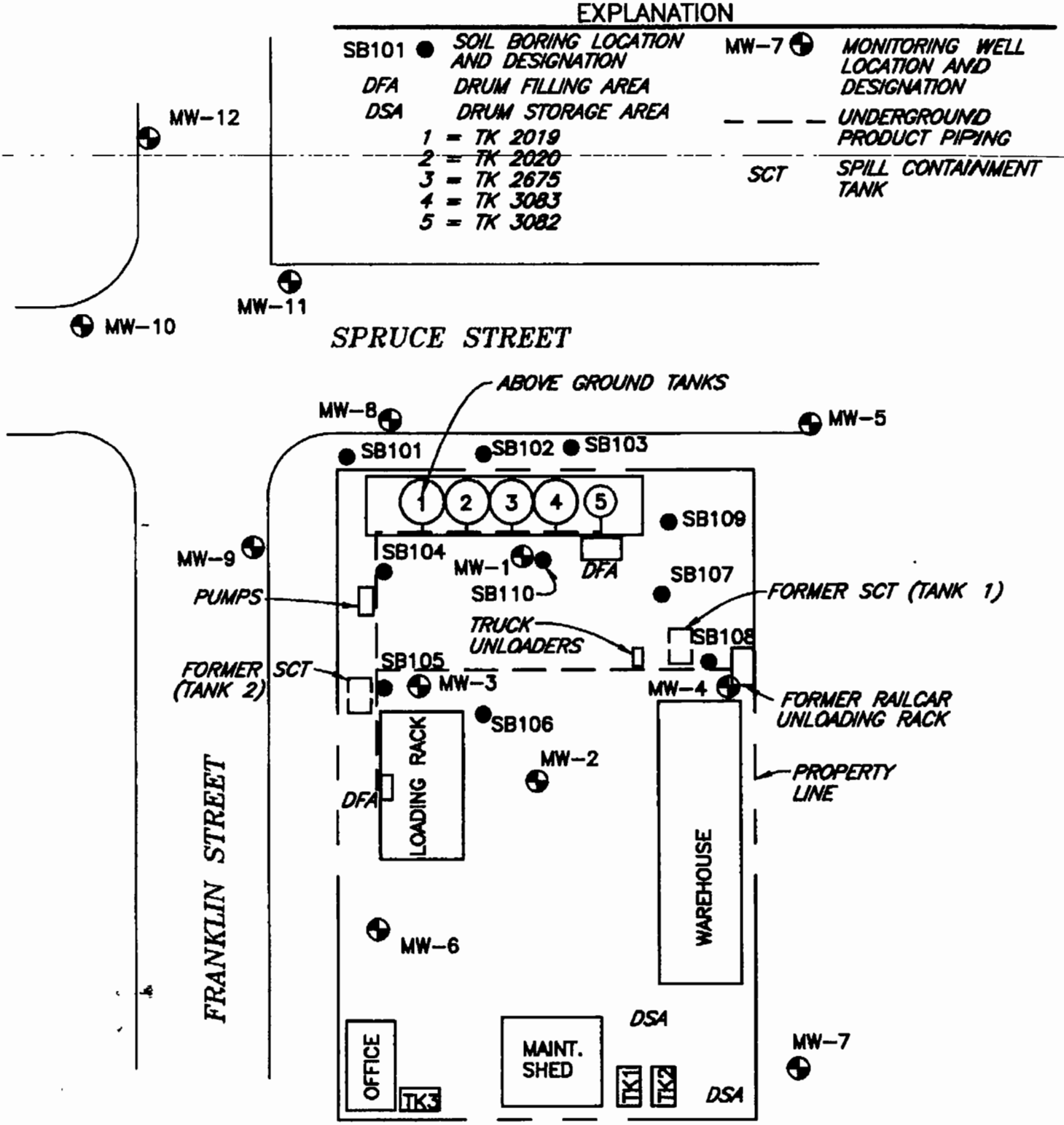
' "Prime" indicates former tank location with same tank number

Former site feature

Existing site feature

Property line

SHN, 1999



TOSCO BULK PLANT #0220
FORT BRAGG, CALIFORNIA

1"=40'

SITE PLAN

SHN 098185.100
AUGUST, 1999

FIGURE **2**

TABLE 1
SOIL ANALYTICAL RESULTS
APRIL 24, 1998
TOSCO -FORT BRAGG, CALIFORNIA

Sample Location	Sample Depth (Feet)	TPHD[1] (mg/kg)	TOC %	Moisture Content %	TCLP ug/L
SB 101-4	4	**2.0**	--	--	--
SB 101-8	8	**4.4**	--	--	--
SB 101-10	10	<1.0	--	--	--
SB 102-4	4	<1.0	--	--	--
SB 102-8	8	**12**	--	--	--
SB 102-12	12	**3.0**	--	--	--
SB 103-8	8	<1 0	--	--	--
SB 103-12	12	<1 0	--	--	--
SB 104-8	8	<1.0	--	--	--
SB 104-10	10	**2.5**	--	--	--
SB 105-8	5	<1 0	--	--	--
SB 105-11	11	**2.7**	--	--	--
SB 106-8	8	<1.0	--	--	--
SB 106-12	12	**2.1**	--	--	--
SB 107-4	4	**5.8**	--	--	--
SB 107-8	8	**1.7**	--	--	--
SB 107-12	12	**5,300**	0 36	14	150,000
SB 108-8	8	<1 0	--	--	--
SB 108-12	12	**4.8**	--	--	--
SB 109-4	4	**2,700**	--	--	--
SB 109-8	8	**450**	--	--	--
SB 109-12	12	<1.0	--	--	--
SB 110-8	8	<1 0	--	--	--
SB 110-12	12	**1.2**	--	--	--

1) TPHD - Total petroleum hydrocarbons as diesel, analyzed in accordance with EPA Method No 8015 Mod, reported in micrograms per liter
2) Total organic carbon (%) analyzed in accordance with the Walkley Black Method
3) Percent moisture analyzed in accordance with the EPA Method 160 3
4) TCLP extract in soil measured in accordance with EPA 3510/8015 modified
5) Gasoline and unidentified hydrocarbons >C8
6) Surrogate recovery was below detection limit due to sample dilution
7) Diesel and unidentified hydrocarbons <C14
8) Diesel and unidentified hydrocarbons <C14, >C16

The seepage velocity (V_s) is calculated by multiplying the hydraulic conductivity by the hydraulic gradient (i) and dividing by the effective porosity (n)

$$V_s = Ki/n$$

Using the hydraulic gradient observed for the 2nd quarter of 1999 (i = 0.02 ft/ft), an effective porosity of 0.25 for silty gravels, and a hydraulic conductivity of 0 036 cm/sec (average K for MW4), the seepage velocity for the 2nd quarter of 1999 was 0 00009 ft/sec.

TABLE 2
AQUIFER SLUG TEST RESULTS
TOSCO FT BRAGG

Well/Test Number	Date	Hydraulic Conductivity (cm/sec)[1]
MW4/Test No. 1	04/12/99	0 063
MW4/Test No. 2	04/12/99	0.036
MW4/Test No. 3	04/12/99	0 009
MW8/Test No 1	04/12/99	0 059
MW8/Test No. 2	04/12/99	0 046
MW8/Test No 3	04/12/99	0.027
MW11/Test No 1	04/12/99	0 023
MW11/Test No 2	04/12/99	0.033
MW11/Test No. 3	04/12/99	0 031

1 cm/sec - Centimeters per second

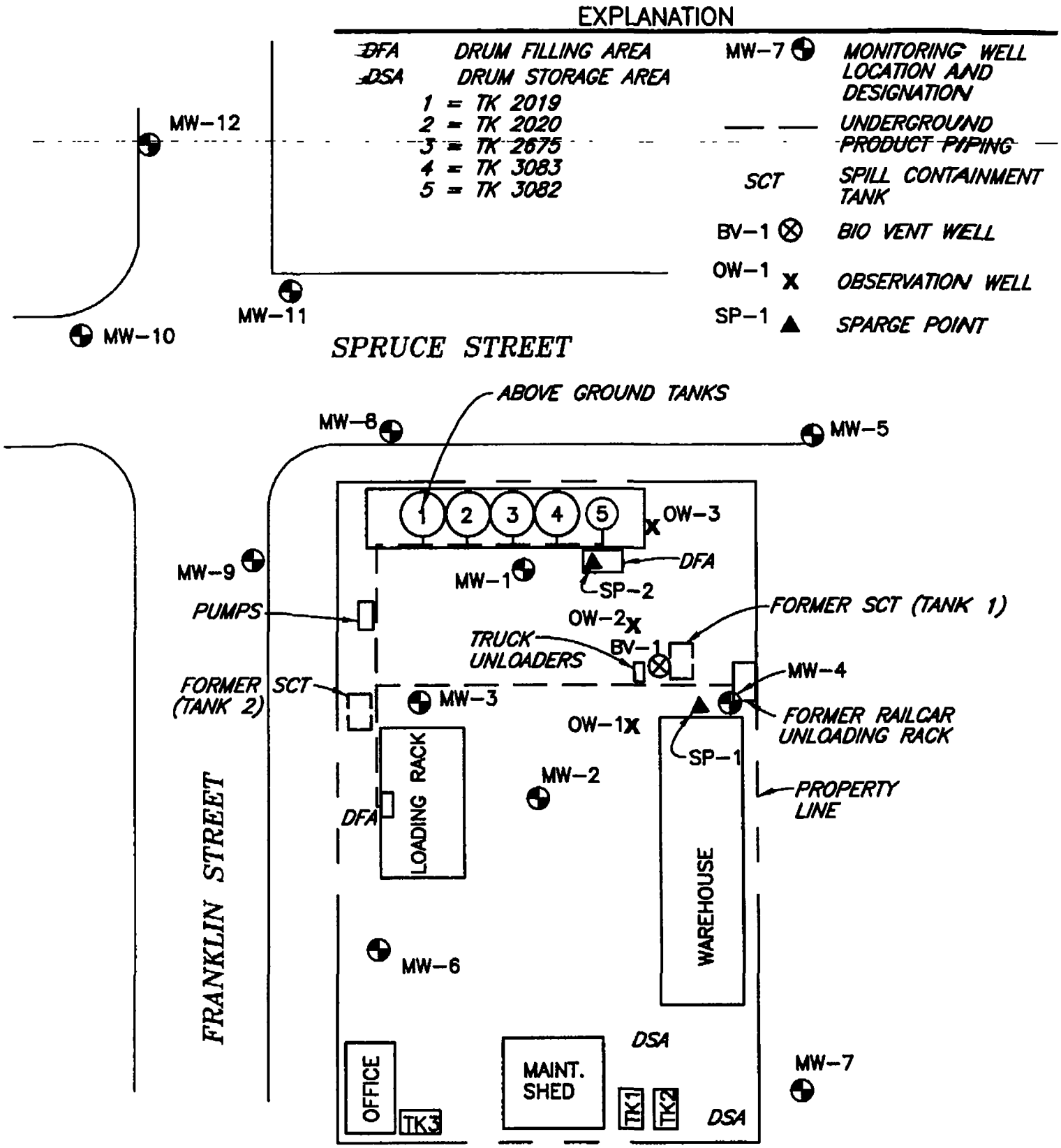
4.4 Groundwater Monitoring

Results for the groundwater monitoring are presented in the Gettler Ryan Second Quarter 1999 Groundwater Monitoring and Sampling Report. Groundwater monitoring data and analytical results for TPHD, TPHG, BTEX, and MTBE are summarized in Appendix F. Dissolved oxygen concentrations are summarized in Appendix G Groundwater analytical results showing the results of the TPHD fuel fingerprinting analysis and indicators of bioremediation are presented in Appendix H

Fuel fingerprint analysis indicates that the bulk of the TPHD detected was in the kerosene range (C10 -C16). A comparison of chromatograms from MW8 and MW11 indicate that contamination detected in these wells is from a common source MW4 had elevated levels of unidentified hydrocarbons, which were detected primarily in the kerosene range (Appendix I)

The greatest activity of biodegradation appears to be occurring in source wells MW4 and MW8 as evident by elevated levels of carbon dioxide, methane, and soluble iron as well as reduced levels of dissolved oxygen, redox potential, nitrate, and sulfate Table 3 illustrates an intrinsic

SHN, 2000



TOSCO BULK PLANT #0220
FORT BRAGG, CALIFORNIA

WELL LOCATIONS AND SITE PLAN

1"=40'

SHN 098185.100
SEPTEMBER 2000

FIGURE 2

FINICAD/098175/98175F2-2000

TABLE 1
SOIL ANALYTICAL RESULTS
FORMER UNOCAL BULK PLANT #0220
FT. BRAGG, CALIFORNIA
MAY 1, 2000
(Results in mg/kg)

SAMPLE LOCATION	SAMPLE DEPTH (feet)	TPHG[1]	TPHD[2]	B	T	E	X	MTBE
BV-1	16	900	1300	<0 50	1.4	1.9	1.8	<5 0

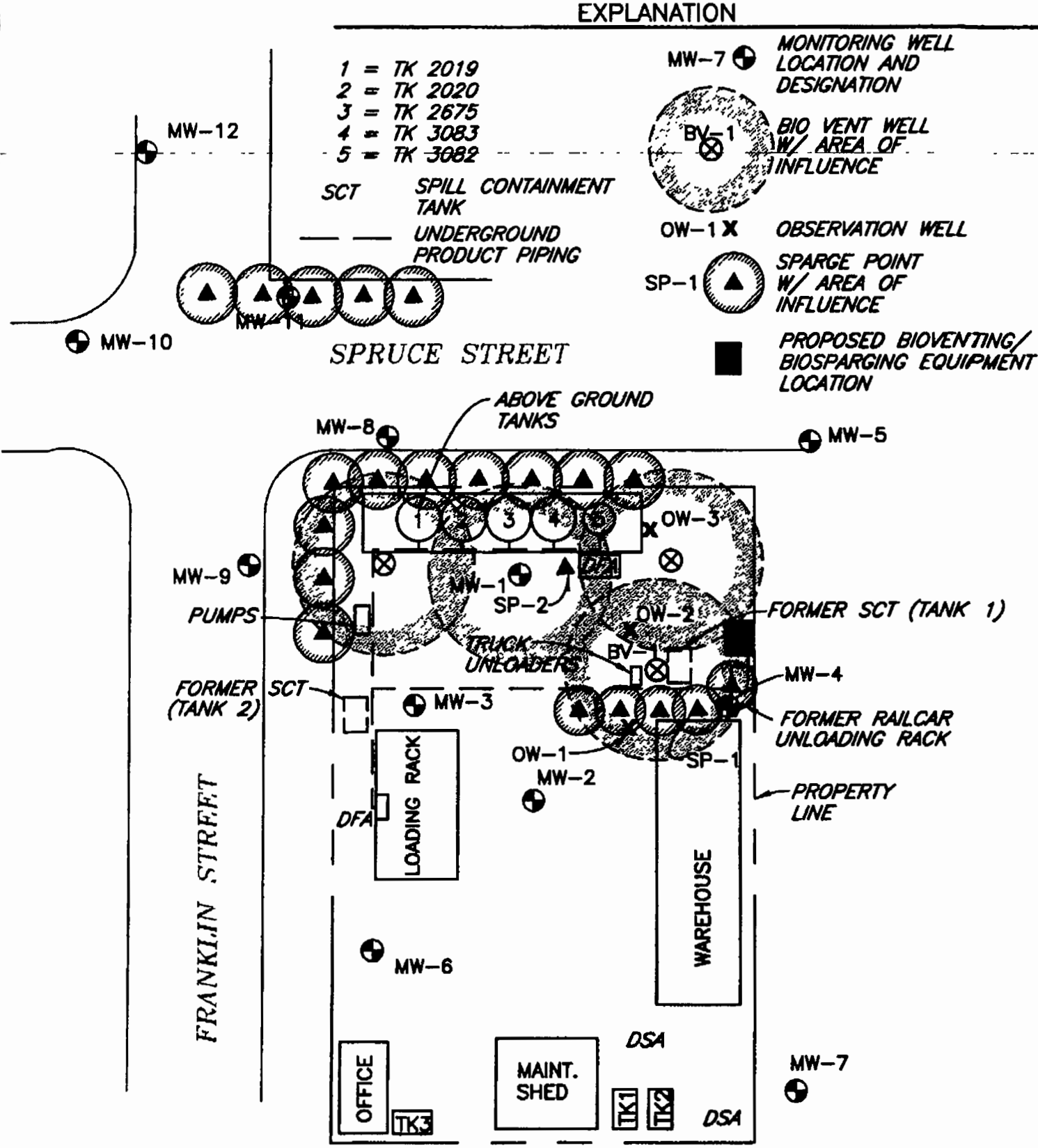
1) Chromatogram Pattern Gasoline C6-C12 + Unidentified Hydrocarbons >C10
2) Chromatogram Pattern Diesel C9-C24 + Unidentified Hydrocarbons <C16

Remedial Design

To evaluate the feasibility of bioventing at the site, SHN used the Bioventing design tool developed by Battelle to calculate the oxygen utilization rate and biodegradation rate Results of the respiration test for each observation well are presented in Attachment 5 These results are summarized in Table 2

Table 2
In Situ Respiration Test Data Analysis
Tosco Ft. Bragg
June 7, 2000

Monitoring Point	Distance from Vent Well (ft)	Oxygen Utilization Rate (%/hr)	Oxygen Utilization Rate (%/d)	Biodegradation Rate (mg/kg-day)
BV-1	0	0 05	1 27	0.55
MW-4	8	0.12	2 89	1 26
OW-1	24	0 03	0 77	0 33
OW-2	30	0 05	1.23	0 54
OW-3	46	-0 002	-0.06	-0.03



TOSCO BULK PLANT #0220
FORT BRAGG, CALIFORNIA

PROPOSED BIOVENTING/BIOSPARGING AND SITE PLAN

SHN 098185.100
OCTOBER 2000

FIGURE 3

FINICAD/098185/98185F2-200C

CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash * Eureka, CA 95501-2138 * Tel: 707/441-8855 * FAX: 707/441-8877 * E-mail: dwinfr@slnn-engr.com

BIOVENTING PILOT TEST MONITORING WELL DATA SHEET

CLIENT: Tosco

LOCATION: Ft Ord #99

PROJECT #: 098185.150

DATE: 6/7/00

RECORDED BY: M. Evget

Well Casting I.D. (inches)	Gal/Ft
2	0.163
4	0.653
6	1.469

Time	Location: MW-4 Distance to Sparge Purge t (min): 5 Well (ft): 6				Location: OW-1 Distance to Sparge Purge t (min): 2 Well (ft): 24				Location: OW-2 Distance to Sparge Purge t (min): 2 Well (ft): 30				Location: OW-3 Distance to Sparge Purge t (min): 2 Well (ft): 46			
	Pres. ("H_2O)	PID (ppm)	O_2 (%)	CO_2 (%)	Pres. ("H_2O)	PID (ppm)	O_2 (%)	CO_2 (%)	Pres. ("H_2O)	PID (ppm)	O_2 (%)	CO_2 (%)	Pres. ("H_2O)	PID (ppm)	O_2 (%)	CO_2 (%)
9:20	-0.06	33	11.7	4.5%	-0.05	13	19.1	1.5	0	11.5	16.6	4.5	-0.02	10.7	16.8	4%
11:00	0.1				0.03				0.04				0.04			
11:45	0.03				0.02				0.02				0.01			
13:00	0.03	87	15.1	3.5	0.02	4.3	19.7	1%	0.03	1.9	16.8	4.5	0.02	1.1	16.9	3.5
14:00	0.03	124	15.2	3.0	0.02	0.3	20.4	0.5%	0.02	0.3	17.2	3.5	0.01	0.0	17.8	4.0
15:15	0.02	94	17.5	2.0	0.02	1.9	20.6	1%	0.00	0.3	17.5	4.0	0.00	0.0	17.7	4.0
16:30	0.04	155	16.8	2.0	0.04	2.5	20.7	1%	0.05	0.3	17.9	4.0	0.02	0.3	17.4	4.5
17:30	0.03	173	18.9	1.5	0.00	3.3	20.9	0.5%	0.06	1.9	18.7	3.0	0.03	0.3	17.8	4.0
18:30	0.06	210	18.0	0.5	0.03	1.9	20.9	0	0.02	0.3	19.1	3.5	0.05	0.0	18.8	5.0
18:45	0.0	200	18.4	0.5	0.0	1.9	20.9	0.5	0.0	0.3	19.2	3.5	0.0	0.3	18.1	4.0
19:45		90	19.5	1%		0	20.9	1%		0.0	19.2	4.0		0.0	17.7	4.0

"Hg = Inches Mercury
"H_2O = Inches Water
PID = Photo Ionization Detector
O_2 = Oxygen
CO_2 = Carbon Dioxide
ppm = Parts Per Million as Hexane
deg F = Degrees Fahrenheit
Purge t = Purge time in minutes

DTW water before test - 13.9'

CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash * Eureka, CA 95501-2138 * Tel: 707/441-8855 * FAX: 707/441-8877 * E-mail: [illegible]@shn-engr.com

BIOVENTING PILOT TEST

SPARGING

SP1

CLIENT: Tosco
LOCATION: Ft Bragg
PROJECT #:
DATE: 6/[illegible]/00
RECORDED BY: Foget

START 12:05 FINISH 5:00
BAROMETRIC PRESSURE ("Hg)
AMBIENT AIR TEMP. (deg. F)

	Injection Well		Vapor					Blower			
Time	Depth to Water	Injection Well Pressure ("$H_2$0)	Total Flow Rate cfm (~~SCFM~~)	Dilution Well Flow (By Dif. SCFM)	Well Flow (By Dif. SCFM)	Carbon Dioxide (ppm)	Oxygen (percent)	Inlet Relative Humidity (%)	Blower Pressure psi (~~"H_2O~~)	Blower Inlet Air Temp (deg F)	Blower Discharge Air Temp (deg F)
12:00		0	0						0		
12:05	Start										
12:10		19	830						19		
12:20		14	860						14		
12:30		12	858								
12:45		10.5	890	↓ flow							
12:56		9.5	830								
13:15		10	850								
13:30		10	905	↑ flow	to 10cfm						
13:30		15	1730								
13:45		14.5	1805								
14:00		13.5	1775								

"Hg = Inches Mercury
"H2O = Inches Water
SCFM = Standard Cubic Feet Per Minute
FID = Flame Ionization Detector
GAC = Granular Activated Carbon
ppm = Parts Per Million as Hexane
deg F = Degrees Fahrenheit

Static DO Before test – [illegible] / 1.21 [illegible]

14:20	13.5	1800
15:00	13.0	1835

shut down

CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W Wabash * Eureka, CA 95501-2138 * Tel: 707/441-8855 * FAX: 707/441-8877 * E-mail: shninfo@shn-eng.com

BIOVENTING PILOT TEST MONITORING WELL DATA SHEET

Sparging

CLIENT: Tosco
LOCATION: Ft Bragg
PROJECT #: 04 8185.150
DATE: 6/8/00
RECORDED BY: M Foget

Well Casting I.D. (inches)	Gal/Ft
2	0.163
4	0.653
6	1.469

Time	Location: BW-1 Purge t (min): Distance to Sparge Well (ft): 18 Pres. ("H2O)	PID (ppm)	O2 (%)	CO2 (%)	Location: MW-6 Purge t (min): Distance to Sparge Well (ft): 15 Pres. ("H2O)	PID (ppm)	O2 (%)	CO2 (%)	Location: BW-1 Purge t (min): Distance to Sparge Well (ft): Pres. ("H2O)	PID (ppm)	O2 (%)	CO2 (%)	Location: SP-1 Purge t (min): Distance to Sparge Well (ft): 16.5 Pres. ("H2O)	PID (ppm)	O2 (%)	CO2 (%)
12:20	0.02				0.03				0.01				0.00			
13:15	0.02	20	19.2	1%	0.03	1.75	5.2	2.5	0.00	3.8	20.3	1.5	0.01	1.9	18.3	4.0
14:30	0.02	80	17.2	0.5%	0.02	1.75	7.8	3	0.02	3.8	20.3	2	0.03	1.9	18.1	3.5
15:45		66	16.0	1%		1.79	8.0	3		1.9	20.3	2	"	1.9	18.3	3.0
													"			

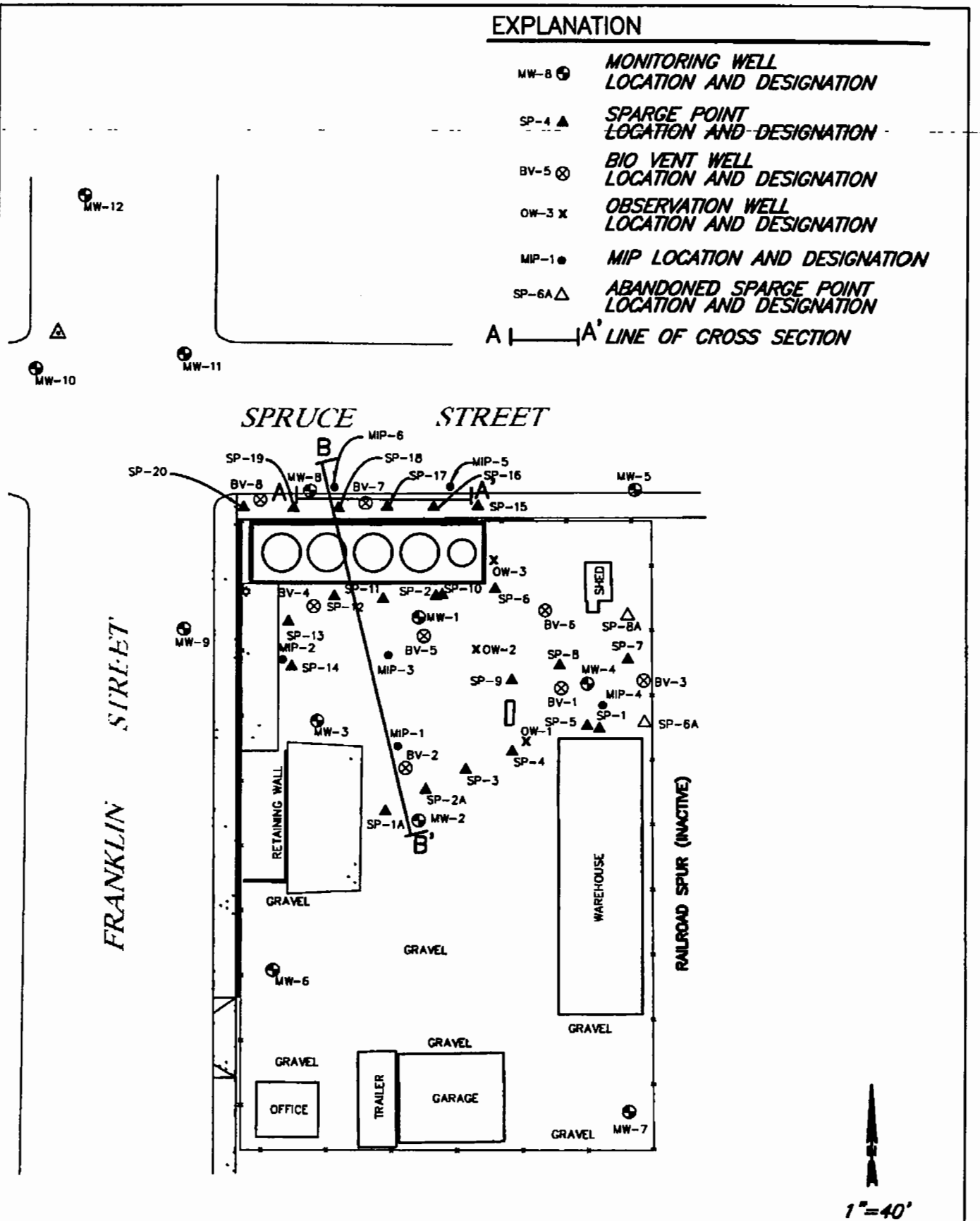
"Hg = Inches Mercury
"H2O = Inches Water
PID = Photo Ionization Detector
O2 = Oxygent
CO2 = Carbon Dioxide
ppm = Parts Per Million as Hexane
deg F = Degrees Fahrenheit
Purge t = Purge time in minutes

15:00 shut down DO After BS-1 - 0.84 mg/L
MW4 - 1.31 mg/L } 16:00
BW-3 - 63' from SP1

G:\1998\098185\100\rpt\pilot study work plan LTR MF.doc

SP1 DO after test

(SHN, 2004)



SHN Consulting Engineers & Geologists, Inc	Conoco Phillips Bulk Plant #0220 Fort Bragg, California	Site Plan SHN 098185 210	
	June 2004	0098185-210-may-site	Figure 2

Table 1
Soil Analytical Results, October 2003
Former Unocal #0220, Ft. Bragg, California
(in mg/Kg)[1]

Sample Location	TPHD[2]	TPHG[3]	B[4]	T[4]	E[4]	X[4]	MTBE[5]	LEAD
SP-1A @ 16 5'	240	80	<0 62[6]	<0 62	<0 62	<0 62	<0 62	4.4
SP-5 @ 16'	620	180	<0.62	<0 62	<0 62	<0.62	<0.62	5.4
SP-7 @ 14'	1,300	380	<1.2	<1 2	<1 2	<1 2	<1 2	7.6
SP-9 @ 16 5'	190	80	<0.62	<0 62	<0 62	<0.62	<0.62	4.8
SP-13 @ 14'	540	710	<3.1	<3 1	<3.1	<3.1	<3.1	4.5
SP-18 @ 13 5'	1,200	14	<0 62	<0 62	<0 62	<0.62	<0.62	4.2
SP-20 @ 14.5'	37	46	<0 62	<0 62	<0 62	<0.62	<0 62	4.0

1 mg/Kg· milligrams per Kilogram
2 TPHD Total Petroleum Hydrocarbons as Diesel, analyzed in accordance with EPA Method 3550/GCFID.
3 TPHG Total Petroleum Hydrocarbons as Gasoline, analyzed in accordance with EPA Method No. 5035/8021B.
4 BTEX Benzene, Toluene, Ethylbenzene, and Xylene, analyzed in accordance with EPA Method 5035/8021B.
5. MTBE Methyl Tertiary-Butyl Ether, analyzed in accordance with EPA Method 5035/8021B.
6 < Denotes less than the method detection limit

Table 2
Background Monitoring, April 1, 2004
Former Unocal #0220, Ft. Bragg, California

Sample Location	Depth to Water[1] (feet)	Groundwater DO[2] (mg/L)[3]	Well Head Space		
			CO_2[4] (%)	O_2[5] (%)	VOC[6] (ppm)[7]
MW-1	11 13	2.90	3 7	16.3	460
MW-2	10 78	5 60	3 4	14.3	480
MW-3	10 78	2 60	7.8	9.7	620
MW-4	11 86	0 11	3.2	15.8	460
MW-8	9.87	0 03	2 4	19.5	400
OBS#1	NM[8]	NM	4.0	17.3	480
OBS#3	NM	NM	4 4	17.2	500

1 Depth to Water from the Top of Casing
2 DO Dissolved Oxygen
3 mg/L milligrams per Liter
4 CO_2 Carbon Dioxide
5 O_2 Oxygen
6 VOC· Volatile Organic Compounds
7 ppm parts per million
8 NM Not Measured

The ozone system is currently operated on a continuous basis Ozone is injected into one sparge well at a time and cycles though all 20 wells before injecting ozone into the first sparge well again The break-in oil of the air compressor was replaced after 20 hours of operation and then again after an additional 200 hours of operation. Additional oil changes will be conducted every month or after approximately 500 hours of operation Start-up of the ozone sparge system was initially attempted in April 2004, but equipment problems prevented full operation until May 26, 2004.

Table C-1
Ozone Sparge Well Construction Data
Former Unocal Bulk Terminal #0220, Fort Bragg, California

Well ID	Well Diameter (inches)	Date Installed	Total Depth (feet BGS[1])	Screened Interval (feet BGS)	Elevation (feet MSL)[2]
SP-1A	1	10/08/03	17 85	15 85-17-85	NS[3]
SP-2A	1	10/08/03	18 25	16 25-18 25	NS
SP-3	1	10/08/03	18 25	16 25-18 25	NS
SP-4	1	10/08/03	18 25	16 25-18 25	NS
SP-5	1	10/08/03	15 75	13 75-15 75	NS
SP-6	1	10/10/03	17.10	15 10-17 10	NS
SP-6A	1	10/08/03	13	--[4]	--
SP-7	1	10/08/03	16 25	14 25-16 25	NS
SP-8	1	10/10/03	16 95	14 95-16 95	NS
SP-8A	1	10/08/03	10	--	--
SP-9	1	10/10/03	17.15	15.15-17 15	NS
SP-10	1	10/07/03	17 65	15 65-17 65	NS
SP-11	1	10/07/03	15 50	13 50-15 50	NS
SP-12	1	10/07/03	15 95	13 95-15 95	NS
SP-13	1	10/07/03	15 80	13 80-15 80	NS
SP-14	1	10/07/03	15 60	13 60-15 60	NS
SP-15	1	10/07/03	14 50	14 50-12 50	NS
SP-16	1	10/07/03	15 00	13 00-15 00	NS
SP-17	1	10/07/03	15 00	13 00-15 00	NS
SP-18	1	10/06/03	17 00	15 00-17 00	NS
SP-19	1	10/07/03	14 70	12-70-14 70	NS
SP-20	1	10/07/03	15 50	13 50-15 50	NS
BV-1	4	5/1/00	15	5-15	78 71
BV-2	4	10/9/03	14 85	4 85-14 85	77 33
BV-3	4	10/8/03	14 5	4 5-14 5	78 92
BV-4	4	10/9/03	14 4	4 4-14 4	75 80
BV-5	4	10/9/03	14 5	4 5-14 5	77.08
BV-6	4	10/9/03	14 5	4.5-14 5	77 91
BV-7	4	10/9/03	14 65	4 65-14 65	75.31
BV-8	4	10/9/03	14.5	4 5-14 5	74.13

1 BGS Below Ground Surface
2 feet MSL feet above Mean Sea Level
3 NS Not Surveyed
4 -- No well constructed

ATTACHMENT 3
FIELD AND LABORATORY PROCEDURES
Response to RWQCB-NCR Letter Dated June 15, 2006 and Work Plan for additional Site Assessment

Bulk Plant No. 0220
720 North Franklin Street
Fort Bragg, California
SECOR Project No.: 77CP.00927.06.1103

ATTACHMENT 3

SECOR INTERNATIONAL INCORPORATED
FIELD AND LABORATORY PROCEDURES

STANDARD PROCEDURE FOR
HOLLOW STEM AUGER DRILLING

Prior to drilling, the boring locations are marked with white paint or other discernible marking and cleared for underground utilities through USA. In addition, the first five feet of each borehole are drilled with a hand auger or air/water knife to evaluate the presence of underground structures or utilities.

Once predrilling efforts to identify subsurface structures are complete, precleaned hollow stem augers (typically 8 to 10 inches in diameter) are advanced using a drill rig for the purpose of collecting samples and evaluating subsurface conditions. Upon completion of drilling and sampling the augers are retracted and the borehole is either completed as a well or filled with neat cement or bentonite as required by the regulatory agency. In areas where the borehole penetrates asphalt or concrete, the borehole is capped with an equivalent thickness of asphalt or concrete patch to match finish grade.

During the drilling process, a physical description of the encountered soil characteristics (i.e. moisture content, consistency or density, odor, color, and plasticity), drilling difficulty and soil type as a function of depth are described on boring logs. The soil cuttings are classified in accordance with the Unified Soil Classification System (USCS). In addition, the sample recovery and sampler penetration are also noted on the boring logs

Soil cuttings are temporarily stored on-site in 55-gallon DOT-approved drums pending waste profiling and proper disposal. A label is affixed to the drums indicating the contents of the drum, suspected contaminants, date of drilling, borehole number, and depth interval from which the contents were generated.

STANDARD PROCEDURE FOR SOIL SAMPLING
SPLIT SPOON SAMPLING

The precleaned split spoon sampler lined with three 6-inch long brass or stainless steel tubes is driven 18 inches into the underlying soils at the desired sample depth interval. The sampler is driven by repeatedly dropping a 140-pound hammer a free fall distance of 30 inches. The number of blows (blow count) to advance the sampler for each six-inch drive length are recorded on the field logs. Once the sampler is driven the full 18-inch drive length or the sampler has met refusal (typically 50 blows per six inches), the sampler is retrieved.

Of the three sample tubes, the bottom sample is generally selected for laboratory analysis. The sample is carefully packaged for chemical analysis by capping each end of the sample with a Teflon sheet followed by a tight-fitting plastic cap and sealing the cap with non- volatile organic compound (VOC), self-adhering silicon tape. A label is affixed to the sample indicating the sample identification number, borehole number, sampling depth, sample collection date and time, the sampler's name, job number, etc. The sample is then annotated on a chain-of-custody form and placed in an ice-filled cooler for transport to the laboratory.

The remaining soil samples are used for soil classification and field evaluation of headspace volatile organic vapors, where applicable, using a PID or flame-ionization detector calibrated to a calibration gas (typically isobutylene or hexane). VOC vapor concentrations are recorded on the boring logs.

STANDARD PROCEDURE FOR GROUNDWATER MONITORING WELL CONSTRUCTION AND DEVELOPMENT

Groundwater monitoring wells are constructed by inserting or tremmieing well materials through the annulus of the hollow stem auger. The screen interval is selected to monitor the discrete water bearing zone and maintain a proper seal at the surface (minimum three feet), and to avoid penetrating other permeable strata or aquicludes. Groundwater wells are installed in accordance with the conditions of the well construction permit issued by the regulatory agency exercising jurisdiction over the project site.

Once the borehole has been drilled to the desired depth, approximately six inches of filter sand are tremmied to the bottom of the boring. A groundwater monitoring well consisting of Schedule 40 PVC casing containing 0.020-inch perforations is then inserted through the annulus of the hollow stem augers. The well screen is then sandpacked by tremmieing the appropriate filter sand (Monterey No.3 Sand or equivalent) through the annulus between the casing and augers while slowly retracting the augers. During this operation, the depth of the sand pack in the auger is continuously sounded to make sure that the sand remains in the auger annulus during auger retraction to avoid shortcircuiting the well. The sand pack is tremmied to approximately two feet above the screen, at which time pre-development surging is performed to consolidate the sand pack. Additional sand is added as necessary to help assure that the sand pack extends a minimum of two feet above top of screen. Following construction of the sand pack, a two-foot thick, bentonite seal is tremmied over the sand and hydrated in place. The remainder of the borehole is backfilled with neat cement grout. The well head is then capped with a locking cap, and secured with a lock to protect the well from surface water intrusion and vandalism. The well head is further protected from damage with a traffic-rated well box in paved areas or locking steel riser in undeveloped areas. The protective boxes or risers are set in concrete. The details of well construction are recorded on the field logs.

Following well construction, the wells are developed in accordance with agency protocols by intermittently surging and bailing the wells. Development is deemed to be sufficient once pH,

conductivity and temperature stabilize to within 10 percent of the previous two readings. To enable evaluation of groundwater elevation and groundwater gradient, the well heads are surveyed by a licensed surveyor to an assumed or legal bench mark depending on the requirements of the project, in accordance with AB 2886 requirements.

Soil Cuttings and Rinsate/Purge Water Disposal

Wastewater collected during development is contained in 55-gallon, DOT-approved drums and stored on site pending waste characterization and disposal. A label is affixed to the drums indicating the contents of the drum, suspected contaminants, date of generation and the monitoring well number from which the waste water was generated.

STANDARD PROCEDURE FOR EQUIPMENT DECONTAMINATION

Equipment that could potentially contact subsurface media and compromise the integrity of the samples is carefully decontaminated prior to drilling and sampling. Drill augers and other large pieces of equipment are decontaminated using high pressure hot water spray. Samplers, groundwater pumps, liners and other equipment are decontaminated in an Alconox scrub solution, and double-rinsed in clean tap water rinse followed by a final distilled water rinse.

The rinsate and other wastewater are contained in 55-gallon, DOT-approved drums, labeled (to identify the contents, generation date and project) and stored on-site pending waste profiling and disposal.

STANDARD PROCEDURE FOR GROUNDWATER SAMPLING

Depth to Groundwater/LPH Thickness Measurements

Prior to purging each of the wells, the depth to groundwater and thickness of liquid phase hydrocarbons (LPH), if present, within each well casing is measured to the nearest 0.01 foot using either an electronic Solinst water level indicator or an electronic oil-water interface probe. Measurements are taken from a point of known elevation on the top of each well casing as determined in accordance with previous surveys.

Groundwater Monitoring Well Purging

Groundwater wells are purged prior to sampling with a bailer or groundwater pump. Purge water is contained on-site in 55-gallon DOT-approved drums. To help assure that the collected samples are representative of fresh formation water, the conductivity, temperature, and pH of the delivered effluent are monitored and recorded using a Cambridge Hydac meter or another meter similar in nature during

purge operations. Purge operations are considered to be sufficient once successive measurements of pH, conductivity, and temperature stabilize to within 0.1, +/- 3 percent, and +/- 10 percent, respectively.

During purging a minimum of three (3) well volumes, measured including the annular space and the well casing below the groundwater surface, are removed from each well. However, in the case of very slow recharging wells, purging is deemed sufficient if the well contents are evacuated during purge operations. Unless recharge takes more than two hours, wells are sampled once the well is recharged to within in 80 percent of the pre-purge groundwater elevation. For very slow recharging wells (wells pumped dry during purging), samples may be collected after two hours of recharge.

Groundwater Sample Acquisition and Handling

Following purging operations, groundwater samples are collected from each of the wells, using pre-cleaned, single-sample polypropylene, disposable bailers. The groundwater sample is discharged from the bailer to the sample container through a bottom emptying flow control valve to minimize volatilization.

Collected water samples are discharged directly into laboratory provided, pre-cleaned, 40-milliliter (ml) glass vials and sealed with Teflon-lined septum, screw-on lids. Labels documenting sample number, well identification, collection date and time, type of sample and type of preservative (if applicable) are affixed to each sample. The samples are then placed into an ice-filled cooler for delivery under chain-of-custody to a laboratory certified to perform the specified tests by the State of California Department of Health Services Environmental Laboratory Accreditation Program.

Trip Blanks

To help assure the quality of the collected samples and to evaluate the potential for cross contamination during transport to the laboratory, a distilled-water trip blank accompanies the samples in the cooler. The trip blank is typically analyzed for the presence of VOCs of concern. For petroleum hydrocarbons, the trip blank is typically analyzed for TPHg, BTEX, and MtBE by EPA Method 8260B.

Containment and Disposal of Generated Water/LPH

Wastewater, purge water, and LPH (if present) generated during the field activities are retained on-site in appropriate containers (i.e. DOT-approved drums or bulk tanks) for future disposal. Wastewater is delivered under appropriate manifest to a facility certified and licensed to receive such waste streams.

ATTACHMENT 4
REMEDIATION DESIGN CALCULATIONS FOR OZONE SPARGE SYSTEM

Response to RWQCB-NCR Letter Dated June 15, 2006 and Work Plan for additional Site Assessment

Bulk Plant No. 0220
720 North Franklin Street
Fort Bragg, California
SECOR Project No.: 77CP.00927.06.1103

SECOR

Remediation Design Calculations For OZONE Sparge System

Former Bulk Plant No. 0220
720 North Franklin Street
Fort Bragg, CA
SECOR Project No.: 77CP.00927.06.1103

Prepared for:

ConocoPhillips

Prepared by:

SECOR International Incorporated
3017 Kilgore Road, Suite 100
Rancho Cordova, California

July 2006

Ozone Sparge (OS)

Minimum Injection Pressure
(*Air Sparging Design Paradigm*)

Minimum Injection Pressure = (0.43) * (hydrostatic head) + [air entry pressure for the well annulus packing material + air entry pressure for the formation (sand and gravel - assume 0.2 psig per *Air Sparging Design Paradigm*)]

SP-8:

Low groundwater
Minimum Injection Pressure = (0.43) * (0.5 feet) + (0.2 psi) = .4 psi

High groundwater
Minimum Injection Pressure = (0.43) * (5.0 feet) + (0.2 psi) = 2.4 psi

SP-18:

Low groundwater
Minimum Injection Pressure = (0.43) * (2.5 feet) + (0.2 psi) = 1.3 psi

High groundwater
Minimum Injection Pressure = (0.43) * (7.5 feet) + (0.2 psi) = 3.4 psi

Maximum Injection Pressure
(US Army Corps of Engineers *In-Situ Air Sparging*)

$\text{Pressure}_{\text{soil column}} = (\text{depth}_{\text{top well screen}}) * (G_s) * (1-n) * (\rho_{H2O})$

$\text{Pressure}_{H2O\ \text{column}} = (\text{depth}_{\text{top well screen}} - \text{DTW}) * (n) * (\rho_{H2O})$

SP-8:

G_s = Specific gravity of soil = 2.7*(specific gravity of water @ 20 degrees Celsius)
n = Porosity = 30% = 0.30 (Coarse grained silty sand)
$\text{depth}_{\text{top well screen}}$ = 15ft
ρ_{H2O} = density of water= 1.94 slugs/ft^3

g=32.2 ft/s^2
DTW = Depth to water table = 7.5 ft

$P_{soil\ column}$ = (15 ft)*(2.7)*(1-0.30)*(1.94 $\frac{slugs}{ft^3}$)*(32.2 $\frac{ft}{s^3}$) = 1769.0 $\frac{lb_f}{ft^2}$ = 12.3 psi

$P_{H2O\ column}$= (15 ft – 7.5 ft)*(0.30)* (1.94 $\frac{slugs}{ft^3}$)*(32.2 $\frac{ft}{s^3}$) = 140.4 $\frac{lb_f}{ft^2}$ = 1.0 psi

Total Overburden Pressure = $P_{soil\ column}$ + $P_{H2O\ column}$ = 12.3 psi + 1.0 psi = 13.3 psi

$P_{injection}$ = 0.6*(Total Overburden Pressure) = 0.6*(13.3 psi) = 8.0 psi

SP-18:

G_s = Specific gravity of soil = 2.7*(specific gravity of water @ 20 degrees Celsius)
n = Porosity = 30% = 0.30 (Coarse grained silty sand)
depth $_{top\ well\ screen}$ = 15 ft
ρ_{H2O} = density of water= 1.94 slugs/ft^3
g=32.2 ft/s^2
DTW = Depth to water table = 10.0 ft

$P_{soil\ column}$ = (15 ft)*(2.7)*(1-0.30)*(1.94 $\frac{slugs}{ft^3}$)*(32.2 $\frac{ft}{s^3}$) = 1769.0 $\frac{lb_f}{ft^2}$ = 12.3 psi

$P_{H2O\ column}$= (15 ft – 10.0 ft)*(0.30)* (1.94 $\frac{slugs}{ft^3}$)*(32.2 $\frac{ft}{s^3}$) = 93.6 $\frac{lb_f}{ft^2}$ = .7 psi

Total Overburden Pressure = $P_{soil\ column}$ + $P_{H2O\ column}$ = 12.3 psi + .7 psi = 13.0 psi

$P_{injection}$ = 0.6*(Total Overburden Pressure) = 0.6*(13.0 psi) = 7.8 psi

Air Flow

Based on the AS design paradigm and design calculations, air flow will be 15-20 scfm at mean sea level (MSL) at the test well, with an injection pressure between 2.4 psi- 8.0 psi at SP-8 and 3.4 psi – 7.8 psi at SP-18.

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INCORPORATED

www.secor.com
3017 Kilgore Road, Suite 100
Rancho Cordova, CA 95670
916-861-0400 TEL
916-861-0430 FAX